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THE GEOGRAPHICAL JOURNAL

Vol. LXIV No. 2 August 1924

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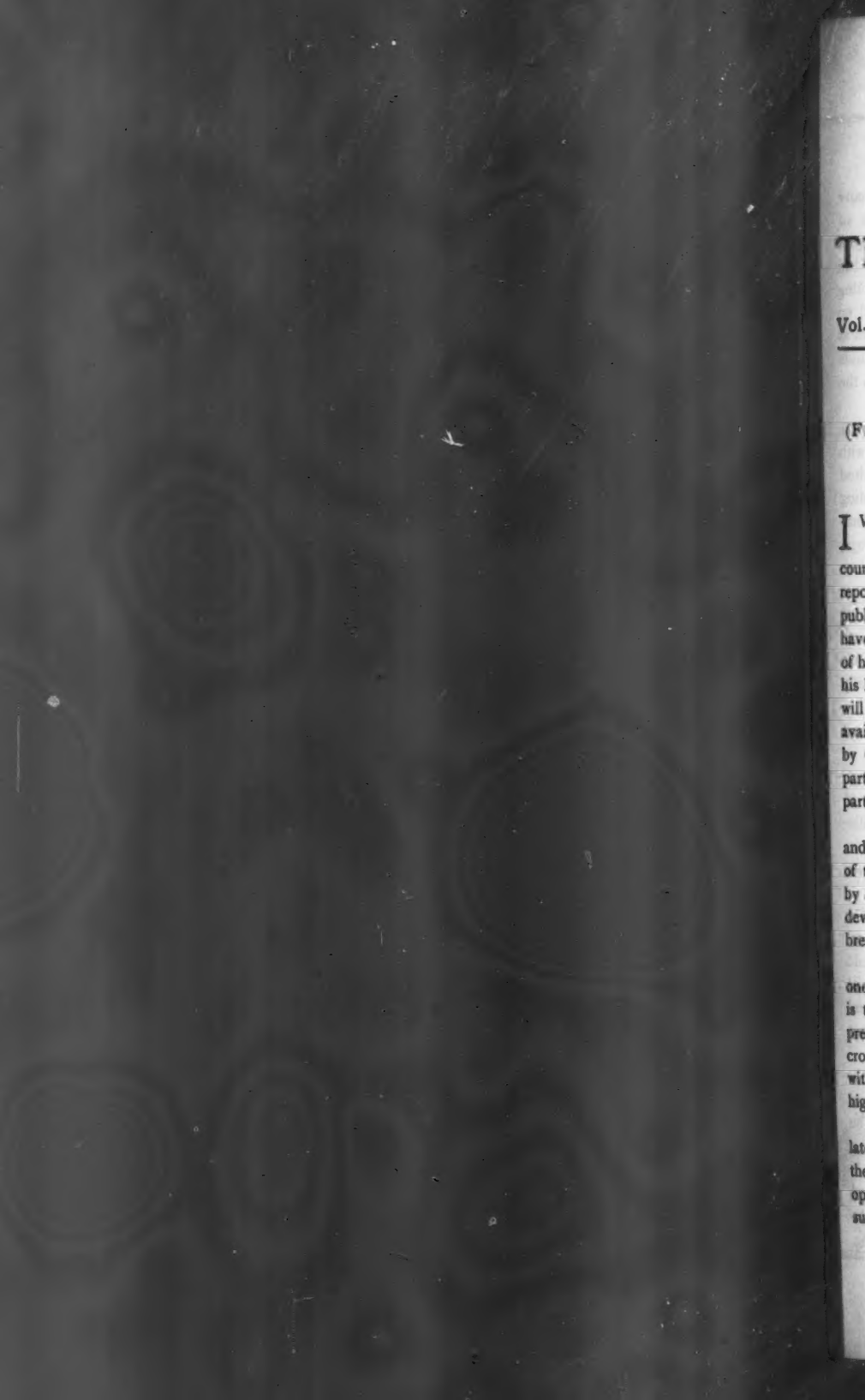


The Geographical Journal

Vol. LXIV No. 2 August 1924

PEKING TO LHASA

(From the diaries of the late Brig.-Gen. George Pereira)

Major-General Sir Cecil Pereira

Read at the Meeting of the Society, 16 *June* 1924

I WELCOME this opportunity of giving a brief outline of some of my brother, Brigadier-General George Pereira's work. During the course of over twenty years of travel in China he had made many official reports, but with the exception of a few letters to newspapers, the general public knows nothing of his work and travels. It was his intention to have returned to England at the beginning of this year and write a record of his travels, but he was not spared to do this; the diaries and letters of his last journeys are now being edited and will shortly be published and will give a more detailed account than I can give in the limited time available for a lecture. I propose to-night to point out the routes followed by General Pereira in his last journeys, referring to a few places of particular interest, but to confine myself principally to the most important part of the journeys, from Tangar to Lhasa.

General Pereira started the Peking to Lhasa journey in February 1921 and passed through an area stricken by a big famine that affected parts of the provinces of Chihli, Western Shansi, and Honan. It was caused by a failure of the crops, and hundreds of thousands perished. Far more devastating are the floods that affect this area when the Yellow River breaks its embankment and the number of deaths runs into millions.

The Hwa Shan in Shensi Province was reached in April 1921; it is one of the five sacred mountains of China and has the finest scenery and is the hardest to climb of the five. It is a mountain of pinnacles and precipices, the five main pinnacles, some of which look inaccessible, being crowned with temples, and they are approached by steps cut in the rock with chains to assist the pilgrims up and down the steep sides. The highest pinnacles are over 8000 feet.

Sian, the capital of the Province of Shensi, was reached a few days later. Like the rest of China this province was in a state of civil war, the northern part being under control of the military governor and opposed by a party in the south under a Han Kin scholar, who was supported by the leader of the local brigands.

Not only are there internal dissensions in provinces, but many provinces are at war with one another. Then there is the curse of brigandage, which is widespread. In many cases the origin of the brigand bands is that soldiers have been left for months without pay or food and they have deserted, taking their arms and ammunition, and live by looting the countryside and caravans. The local authorities usually insisted on sending an escort with General Pereira, and he describes these escorts as being very useless. His caravan was only once attacked and the brigands were driven off without difficulty. As escort and brigands all fired in the air there were no casualties.

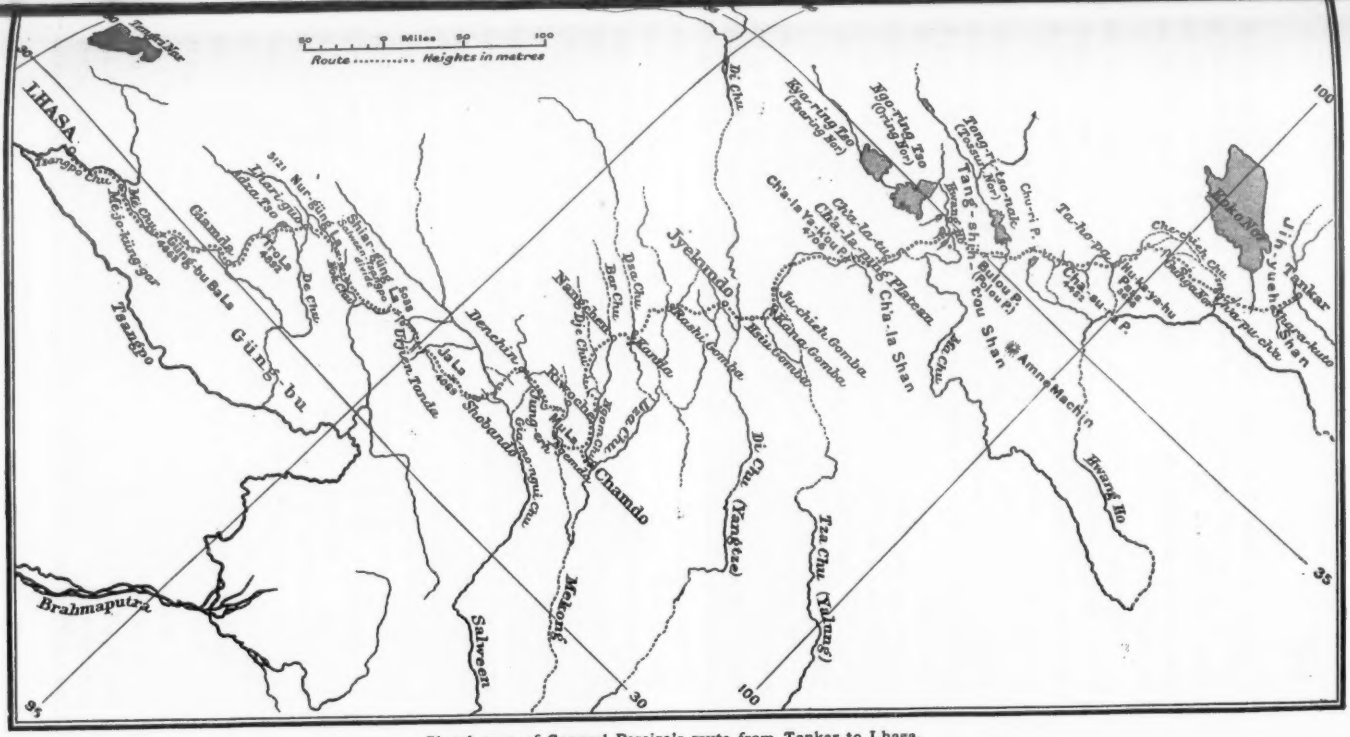
On July 19 General Pereira left Kiung-chow-sze for the Mu-p'ing district in Western Szechwan, a wild mountainous country covered with dense scrub and bamboo, except on the higher slopes, and uninhabited except for a few visiting wood-cutters and Chinese farmers. The shooting grounds were at altitudes between 7000 and 13,000 feet. The game comprises boar, bear, roe, leopard, giant pandar, pandar cat, serow wild dogs, and, on the highest ground, takin and blue sheep. The local hunters are useless; they are not keen, they know little of the habits of the game or where to find them, and this, combined with the thick jungle, made it purely a matter of luck if game was shot. General Pereira was particularly keen to get a giant pandar or pandar bear, as no European has ever shot one, but though he found traces of them he never actually saw one.

The physical exertion of climbing up very steep slopes and forcing a way through very dense bush was very great; climbs of 2000 feet or more being the general rule, and with the added discomfort of leeches, which are plentiful in places on the lower slopes. Having constantly to ford streams and negotiate slippery rocky surfaces, General Pereira discarded boots and wore native sandals, but they were not an entire success, as they do not protect the feet sufficiently, and a poisoned foot kept him in idleness at Teng-ch'e Kou for seven weeks.

As a reward for his labours General Pereira shot a serow and a pandar cat on his last trip. The cat is now in the British Natural History Museum at South Kensington. The weather conditions of cold and wet made a longer stay in the last hunting camp at an elevation of nearly 10,000 feet quite impossible. Heavy snow had fallen and there was every chance of the party being snowed up if they remained at that altitude.

As a result of having to walk 46 miles back to Teng-ch'e-Kou in deep snow, with the small protection afforded by sandals, General Pereira had four toes partially frostbitten on one foot, and from there he had to be carried in a chair to Chengtu, which he reached after seven days on November 14.

We now get to the important part of the journey. Tangar was reached on 10 April 1922, and it was here that the preparations for the journey to



Sketch-map of General Pereira's route from Tankar to Lhasa.

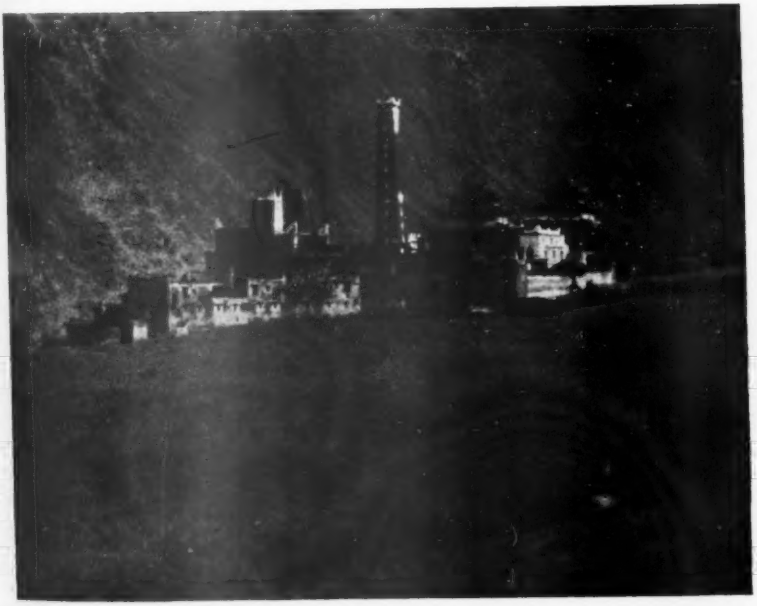
Lhasa were made. Since Abbé Huc's journey seventy-six years previously, no European had reached Lhasa from the east. Many travellers had made the attempt—Mr. Sorenson and Madame Néel, a French lady, immediately previous to General Pereira's journey—they had all been turned back.

For many years it had been General Pereira's ambition to reach Lhasa from the east. A chance occurred when the Chinese conquered Tibet, as the Chinese Amban at Lhasa was a personal friend of his, but unfortunately he was not free at that time to make the attempt.

With the advent of the Chinese Republic in 1912, the Chinese garrison of Lhasa murdered the Amban; and, left without a leader, the Chinese troops were either massacred or driven beyond the Tang La Pass which is on the range which now constitutes the Chino-Tibetan frontier, or else driven south into Sikkim. The Chinese only retained their hold on the easterly Tibetan province, known as Koko Nor in Tibetan or Ch'inghai in Chinese, both names in English meaning "Blue Lake."

The roads leading from Tangar to Tibet had been closed for many years by Golok raids. The Goloks, a Tibetan tribe, were at one time very powerful, with their headquarters near Amné Machin. The Chinese had made several unsuccessful attempts to subdue them, but in 1921 a Chinese general, Ma Ch'i, tackled them and showed distinct genius. His successful attack on the Goloks is most like Gideon's successful attack on the Midianites, when he took three hundred Israelites and armed each man with a trumpet, a pitcher, and a torch which was concealed in the pitcher. They approached the Midianites after dark, and at a given signal they all sounded their trumpets, smashed their pitchers, and waved their torches, and in the confusion the Midianites slaughtered each other. The Chinese general knew that the Goloks always waited for the Chinese to attack them in some position selected in rocky precipitous mountains. As soon as they were attacked they descended upon their enemies and invariably inflicted a heavy defeat upon them. The Goloks were a fine fighting lot and his troops were not reliable. He therefore decided to rule out the fighting qualities of both sides, as they were so adverse to him, and substitute some tactics that would be wholly in his favour. He took some mountain guns with him and a fifth of his force was composed of buglers. When his force was drawn up under the Golok position the mounted guns opened with rapid fire and the buglers sounded their bugles and the Chinese troops charged. The din of the discharge of the guns echoing among the hills, the bursting of the shells among the rocks, and the terrific noise of many bugles struck the Goloks with panic; the Chinese were on them before they could recover, and hemmed in in their mountains a great part of their force was wiped out; the Chinese had practically no casualties. The general who can mystify, mislead and surprise his enemy and who destroys his

LOOKING ALONG RIDGE TO PEI-FENG



PALACE OF CHIEF OF OOJE; KWANCHAI

THE START FROM TANGAR

LOOKING SOUTH UP THE VALLEY TO HSI-FENG

fighting forces accomplishes everything necessary. The Chinese general had done all this, and had permanently opened the road to Lhasa.

But there were other difficulties, the chief one being how to get permission to enter Tibet. Without this permission there was no hope of accomplishing the journey. Travellers had always been turned back at the frontier. One of them, Mr. Sorenson, reached Tangar when General Pereira was there and gave him a lot of very useful information as to the routes he had traversed up to the Tibetan border, and made him an invaluable present, a boiling-point thermometer.

Father Schram, a Catholic missionary, accompanied General Pereira from his mission station at Sinning-fu to Tangar to help in arranging the caravan. He is a fluent Tibetan scholar and he wrote letters in Tibetan which were sent on ahead to important Tibetan officials asking for permission to cross the frontier. There was also a friend in headquarters who probably persuaded the Tibetan Government to give the permission, and the official sanction was received later on in the journey after further correspondence.

Then there were the actual difficulties of the road to be considered, high plateaus and lofty passes to be surmounted, accompanied possibly by great cold, strong winds, and deep snow. This entailed providing tents, one for himself and one for his followers, thick clothing and blankets. No food or forage was obtainable before reaching Jyekundo, this therefore had to be carried. The men's food consisted of Chinese vermicelli called kua-min, flour, butter, dates, and salt. Mr. Sorenson had crossed one long waterless stretch of country.

The next question was transport. General Pereira was badly advised, and he purchased his animals, eight riding horses and fifteen pack mules. We shall see later that this involved him in endless trouble and anxiety on the road during the first part of the journey. His troubles began with the buying. He describes how the wiles of the horse coper are just as prevalent at Tangar as they are in other parts of the world. As to the actual purchase, both in China and Tibet the buyer places his hand inside the loose sleeve of the seller and indicates his offer by the number of fingers he presses with, so that no one else knows the amount offered.

For the latter part of the journey he used the Tibetan "ula" system. Villages or districts in Tibet are bound to provide transport at fixed rates, the head man of the village being responsible for collecting the animals. Where there are no villages on the route there is a house for an official who requisitions the transport from the nomad caravans grazing in the district. To avoid delay in these cases, as animals may have to come from a considerable distance, word is sent on ahead of requirements.

Yaks are nearly always provided, but sometimes a few extremely small donkeys, and on one occasion General Pereira had a few natives to supplement the animals as a sufficient number were not available.

The diary constantly refers to the comfort and lack of anxiety when travelling with "ula" transport; the animals turn up punctually and there are no sick or tired animals. The lengths of the ula stages vary to meet local convenience, and they may be for half a day or for several days; they always stop short of a big river to save the difficulty of getting animals across. The yaks are pure bred, and very different from those found in the Tachienlu area, where the half-bred predominate. White is the predominant colour of the horses, but the most highly prized are dun horses with black tails.

"Ula" transport is very cheap. The cost of an average of twenty yaks from Jyekundo to Chamdo, a distance of 260 miles, was about £12. The cost from Chamdo to Lhasa worked out at £20 10*s*., about 8*d*. a mile for the whole caravan. The personnel of the caravan was picked up at Tangar; he had his boy and cook, and he engaged as interpreter a Chinese who spoke Tibetan, a head man, and four muleteers.

Before beginning an account of the journey I will refer to the difficulty of getting correct names for places. There is the double nomenclature over a great part of Tibet, where the Tibetans and Mongols roam over the same country; and in addition you have Chinese names for certain places. Where it is necessary to rely on the local pronunciation it is difficult to ensure accuracy; it was at times difficult to ascertain which were Tibetan and which were Mongol names as written down by previous travellers. Before leaving Chamdo, General Pereira got a complete list of the stages from Chamdo to Lhasa in Tibetan and in Chinese, and he constantly noted in his diary how, when compared with this list, the Abbé Huc was far more accurate than subsequent travellers or the Indian map.

By May 11 all was ready and the caravan started from Tangar, the first objective being Jyekundo. On May 12 they passed Sharakuto, the last Chinese town, and soon afterwards passed from Kansu into Ch'ing-hai Province. This was the old frontier between Tibet and China, the actual frontier now being the Tang La Range, south-west of Jyekundo.

The second camp was situated in typical Tibetan grassland scenery, hills and valleys, and large herds of yaks grazing in the distance, but not a house or tree to be seen.

The country presented no difficulties during the early stages of the journey, but the days' marches were arduous all the same. It was necessary to rouse the caravan at 4 a.m., and then wait about for two hours so that all was ready for the start at 6 a.m. For example, on May 13, they travelled 24 miles and reached camp, after travelling continuously, at 3 p.m., but some of the mules, including those with the tents, went astray and only reached camp at 5.20 p.m. Those who have had experience of caravan travel will remember that it takes a little while before the time spent between rousing the caravan and starting on the march gets speeded up to within reasonable limits, and it also takes several

days on the road before straggling and going astray is prevented. In fact, the first few days with a new caravan are always tiring and discouraging until everything becomes a matter of routine.

This stage on May 13 was across the large plain which is bounded on the north by the great Koko Nor Range. A little north of the route lay the small salt lake, Wayen Nor, which was formerly worked for salt. There are on this plain a few very small Chinese farming villages; the other inhabitants are the nomad Mongols and Tibetans with their flocks and herds.

Ch'a-pu-ch'a, a village of seventy-five Tibetan and nineteen Chinese families, was reached on May 15. No food—not even an egg—could be bought here.

On May 16, General Pereira was ahead of the bulk of his caravan, with his interpreter, and two mules with their drivers; as there were no signs of the rest of the caravan he sent his interpreter to find them. The interpreter found the caravan but lost him, and, consequently, General Pereira was left in the open foodless and resourceless. A good rest is always useful, and so, using the tent which was on one of the mules as a bed, and borrowing a rug and a coat from the muleteers, he put in eleven hours' sleep. They picked up the caravan the next morning, but he was practically foodless from breakfast one morning until 7.30 p.m. the next day.

Failure to realize that the track divided into two was the cause of this mishap: a longer route to the north with water all the way, which the interpreter knew, and a southern route, shorter, but with a long waterless stretch, which the rest of the caravan followed. Sorenson had been along the southern route when he tried to reach Lhasa.

With the exception of an occasional nomad camp with flocks and herds, a few gazelle, hares, and red-legged partridges, and duck on the lakes, there was very little life seen on these big plains. The grazing is good only in places, as there are large areas of poor soil bearing only scrub, and elsewhere there are sandy dunes.

On May 19 they crossed the Hu-k'a-ya-hu Pass, 12,000 feet, and entered the large Ta-ho-pa grass plain. The Ta Ho runs through a great canyon 600 feet deep, and above the river is a Chinese garrison of seventy Muhamadan soldiers, who lead a desolate life seeing only a few nomads and having an arduous descent and climb for every drop of water they require. No forage was available here, and the caravan was out of beans for the mules. There were a few trees in the Ta Ho Valley, the first trees seen since leaving the Sining Ho Valley.

The weather up till now had been warm during the day but cold at night; but on May 21, the day they left Ta-ho-pa, they were delayed by a snowstorm. However, by the evening all the snow had gone.

The mules had not thriven during the journey, and now with no forage for them they began to fail. The Tibetans in the camps near by

would not hire out their yaks, as there was no escort with the party. Owing to a scare of a raiding Golok party reported to be in the neighbourhood, the Tibetans were drawing close to Ta-ho-pa to be near the protection of the Chinese garrison. In the circumstances General Pereira decided to return to Ta-ho-pa to wait for an escort that General Ma-Ch'i had promised him, but which he had not waited for at Tangar. The escort arrived on May 25, and it consisted of thirty ununiformed men armed with rifles.

On May 25 they crossed the big Chasura Pass (14,600 feet, B.P.) through the Yalung Range, and crossing a plain with poor pasturage and soft going they camped at a height of 14,000 feet. The day had been dull and cloudy, and during the evening there was a strong west wind and sleet. In this area they saw herds of wild asses and occasionally wolves. The transport question was becoming very difficult, and it was necessary to reduce the loads on the mules, and to use some of the horses for transport. General Pereira found that steep climbs, or even long uphill gradients at these heights, were very trying.

On May 26 they crossed the Chu-ri or Chi-da Pass through the Chu-lung Range, 14,500 feet. The going was stony or boggy, the higher hills were snow-covered, and they descended through gloomy valleys to the sandy Luan-ch'uan Plain. It was on this day that he saw Amné Machin Peak, possibly 70 miles away to the south-east, when he was at an altitude of 13,000 feet. He estimated that the height must be at least 25,000 feet, and might be anything; it dwarfed all other mountains near it.

When General Pereira was lying ill at Calcutta at the end of his journey he was interviewed, and the optimistic reporter made him say that Amné Machin might be higher than Everest; but his studied opinion, based on what after all could only be the roughest of estimates made by a traveller who had seen many of the world's highest peaks, was as I have just stated.

On May 28 he crossed the Tung-ri Pass, 13,867 feet. All these passes so far were easy to cross, and there was no considerable climb to reach the summit. From the top he got a view of the beautiful blue Tung-ri-tso-nak, a Tibetan name meaning the Lake of 1000 hills, less poetically named by the Mongols the Butter Lake. At their camp this day they met the first people they had seen since leaving Ta-ho-pa. They found a large encampment of Tibetans of the Gaba tribe and a Muhamadan Tibetan merchant, by name Ma Hua, all bound for Jyekundo.

On May 29 they passed through a gap in the Ch'ang-shih-t'ou Shan Range, which appears to connect up with the range in which is Amné Machin. It was a gloomy day with strong winds and sleet during the afternoon, and the thermometer inside a tent was down to 38°. Several of General Pereira's mules were now absolutely done, and through the good offices of Ma Hua, the Tibetan merchant, he hired four yaks to

supplement his transport as far as Jyekundo. It was a great stroke of luck to have met the Tibetan caravan bound in the same direction, as there was no other possible means of getting the loads along.

The character of the country remained the same, large plains divided by mountain ranges with easy passes and usually very poor pasturage. On June 2 they crossed the West Malayi Pass, 14,500 feet, and later forded the Hwang Ho, or Yellow River, here only a small river 30 yards wide and 2 to 2½ feet deep.

There are not many Europeans who have forded it. The Tibetan name for it is Ma Chu; otherwise General Pereira said that, as far as he was aware, it is the only river in China that keeps its name throughout its course. He said that possibly the Han River kept one name, but he had not seen so much of it as of the Hwang Ho. The other big rivers have different names as they pass through different districts, and small rivers usually have a different name in each village that they pass. Ma Chu, the Tibetan name, means "Mother of Rivers."

The weather conditions were extremely remarkable, and General Pereira's diary often describes them as consisting of a collection of samples. The following describes the weather on one day. At noon, sunshine and summer, followed by a thunderstorm to the south and a hailstorm in camp; two hours later the wind veered round from north to south and there was a snowstorm; during the evening there was again a strong wind from the south and some sun.

The next stages continued across plains and through low passes, with nomad Tibetans, where there was good pasture; and on June 11, having passed over the Cha-la Shan Range, which is the divide between the Hwang Ho and the Yangtze, they camped on the Ch'a-la-ping Plateau at a height of over 15,000 feet. To the south-east lay a range of hills called Mu-mo-di-ya, shown on maps as Bayantukmu, which is possibly a Mongol name, as the Tibetans did not recognize it, neither did they recognize the name Oring Nor for the lake, another Mongol name. They pronounce Amné Machin, Anye Machin.

General Pereira stated that he was the only one in his caravan who appeared to be affected by the altitude, and that a climb of 200 or 300 feet made him gasp for breath, though he was not inconvenienced on the flat.

On June 13 they crossed the Ch'a-la Ya-kou, the highest point between Tangar and Jyekundo, and soon after forded the Ch'a Ho, a stream which eventually becomes the Yalung River.

There is a particular interest in this part of the journey from the fact that from not long before reaching Jyekundo to shortly after leaving Chamdo, the Hwang Ho, Yalung, Yangtze, Mekong, and Salween were all crossed, some of them insignificant streams at this stage, but the mighty Yangtze at Jyekundo is already a river of considerable dimensions.

Ju-chieh Gomba, or monastery, was reached on June 17. It is a

monastery of the Red Sect with one hundred lamas. These buildings and the barracks at Ta-ho-pa and Ch'a-pu-ch'a and the small villages near them were the only buildings seen since entering Tibet.

By this time the mules were at the end of their tether, and fortunately it was possible to make use of "ula" transport. Five yaks were engaged for the three stages to the Yangtze ferry near Jyekundo for 15 ch'ien for the lot = about 3*s*., which cannot be considered exorbitant as it works out at 1*s*. per 100 miles.

On June 19, near Hsiu Gomba, General Pereira notes that he came across scrub and small bushes 2 to 3 inches high, the first he had seen since leaving Ta-ho-pa, but no sign of a tree. He thought the absence of trees might be due to the severe winds that blow so constantly over this exposed area.

They were now down at 12,750 feet and a few miles from the Yangtze. He notes in his diary what a luxury it was to put up in a room in the monastery, and to be free of the gales and cold to which he was exposed in his tent, and he calls attention to a phrase in our military handbooks that "the best bivouac is not equal to the worst billet."

At Hsiu Gomba they halted a day for the hired yaks with the Tibetan caravan to catch them up. One of the loads contained 900 taels in silver and it was delivered perfectly intact.

The Hsiu Gomba, or monastery, is approached by a very narrow path winding up the hillside, and the monks' houses are built in tiers on uneven terraces, are made of mud, have flat roofs, and are painted grey with red and white borders. Below the monastery is a small village of twenty houses.

On June 22 they passed two more monasteries and a few Tibetan farms and crossed the Yangtze at the ferry. The river here is 80 yards wide, with some small rapids, it is muddy and has a strong current. Here the Chinese call it T'ung-t'ien Ho, or Prosperous Heavenly River. The ferry consisted of seven coracles paddled across by one or two men; the animals swam, most of them led by a rope from a coracle. The hired "ula," as is usual when a big river is reached, did not cross, and fresh "ula" was provided on the far side.

On June 23 they followed down the right bank of the Yangtze between hills rising 800 to 1500 feet above the river, passing a few small villages, and saw trees for the first time since leaving Ta-ho-pa—fir trees, willows and others. Jyekundo was reached during the afternoon.

The journey from Tangar had taken thirty-six stages, and the distance was 519 miles. The height of Jyekundo is 12,928 feet, it contains two hundred Tibetan families, and forty either Kansa Muhamadans or Chinese. It is a poor city of mud-built houses on a hillside above the Pa Chu, with a military camp and a Yamen in the outskirts.

The life of the town was best seen down by the river, where it breaks into several channels, forming green grassy islands, on which were pitched

some white tents belonging to Tibetan merchants. Hundreds of small naked boys were playing about in the warm sunshine, girls were playing with skipping ropes, there were groups by the roadside, chatting or turning prayer wheels, and women spinning cotton, altogether a gay and pleasing scene after several hundred miles of very sparsely inhabited country.

General Pereira met Mme. Néel, a French lady, at Jyekundo; she had then been five years in Tibet and China, and half the time was spent in studying in Kumbun Monastery. With her he visited the Jyeku Monastery, which has three hundred lamas of the Red Sect, whose abbot is appointed from a Sakya monastery south-west of Shigatse in Tibet, and is changed every two or three years.

The houses of all Sakya monasteries are painted grey, with red and white borders, except the house of the abbot and a few of the higher monks, which are painted red. It was the second day of the annual festival, and on arrival they found the lamas collected in the courtyard of the temple sitting in a circle round the abbot.

They were reciting prayers and ringing small bells, and General Pereira described them as a villainous-looking lot, than whom it would be difficult to find an uglier collection of men. From the courtyard the monks adjourned to the temple, and when they were all seated each received a large bowl of tsamba, a sort of barley soup with rancid butter floating on it. The principal monks were on raised stools, and received special condiments in addition to the pyramids of rice and rancid butter which were served with the tsamba. Two monks with thick ropes walked about and belaboured the shoulders of any monk caught talking, and for some time the noise of whacking predominated over all other sounds in the temple, one unlucky monk near General Pereira coming in for a special dose.

After the feast a crowd of Tibetans in the courtyard, chiefly beggars, were given the remains of the feast. The horrid smell of rancid butter, besides the dirt of the narrow streets on the hillside where the monastery is situated, made the whole place most unsavoury.

General Pereira left Jyekundo for Chamdo on July 10. He still had his four riding horses and one or two mules that had not been sold, but otherwise he relied entirely on "ula" transport. The country of plains had now been left behind for one of valleys and passes; but whereas the altitude soon after leaving Tangar until shortly before reaching Jyekundo had been over 13,000 feet the whole way, the altitude in the next section was getting lower until Chamdo, 10,500 feet, was reached.

On July 11 they crossed the Shung La, meaning "Middle Pass," the divide between the Yangtze and Mekong, the height of the pass being 15,724 feet, the highest point reached so far. It was a steep climb through bleak valleys and rugged mountains with some patches of snow, followed by an awful stony descent, eventually reaching the nice grass valley of the Jye Chu with good grazing and a wealth of wild flowers,

where there were several Tibetan camps. The length of the stage had been 21 miles, and very fatiguing. Camp was reached only at 7.15 p.m., and it meant a long interval between breakfast and the next meal. This, however, was not an exceptional stage, and once camp was reached there was the laborious work of plotting out the route and writing up the description of the day's route.

On July 12 the first tree region since Ta-ho-pa was met, and hills bordering the valleys were covered with fir trees, scrub, or grass. They passed Rashi Gomba, a monastery of a thousand monks, and later they crossed the Dze Chu, or Mekong, here 80 feet wide and with a very strong current. Only a single coracle was available to ferry them across.

Göche Gomba, which has a small monastery, was reached on July 14. The various stages were very similar; the route lay through grass valleys, between hills rising from 500 to 1500 feet above the valley, sometimes fir-clad, sometimes grass. There were usually one or two passes through the mountain ranges to be crossed, the approaches and descents being generally through bleak valleys and over a boulder-strewn track, the ranges being rugged and rocky, and often of fantastic shapes. Many of the climbs or descents meant a rise or a drop of 2000 feet. Many of the lower valleys afforded good grazing and were covered with wild flowers. At the summits of the passes there were often extensive views over countless ranges, showing that the character of the country had entirely changed from that of the Tangar–Jyekundo section.

On July 16 the Mekong River was met again, and the route followed down its valley for 10 miles to the ferry. There were a few small villages with houses of mud and stone, and a few fields of barley still green but full-grown. The valley here runs between hills, rising to 600–700 feet above the river, and the width varies from a quarter to half a mile. There are many sandbanks with low bush. They crossed at the ferry, and again there was only one coracle to take them over. The river here was only 200 feet wide, but as after each journey the coracle had to be towed half a mile upstream, it took three hours for the caravan to cross. They encouraged the riding horses to swim across by stoning them.

On July 22 Tang-Kwa was reached, and early in the day the Chinese–Tibetan frontier was crossed; to the north is the Tibetan kingdom of Nang-chen under the Chinese, and south of the frontier the country is administered from Chamdo.

General Pereira met near here some Tibetan men whom one would liken to kangaroos, as they were carrying babies in their bosoms with the small infants' heads just peeping out.

Jaraka, on the Ngom Chu, was reached on July 25, and a few miles before getting there they crossed the river by a bridge, consisting of four massive piers about 20 feet square, built of logs and stones; two of the piers are in the stream, with turret-like superstructures, and the roadway

THE CARAVAN BY THE YANGTZE

LOOKING DOWN TANG-KWA VALLEY

LOOKING N.N.W. TO PIENBAR

THE THREE-STORIED HOUSES IN WA-GE-WA

is of uneven planks. It is a wonder how they made the centre piers, as the river here is a raging torrent surging against them.

The Tibetan women in this area black their cheeks with grease, as mentioned by the Abbé Huc, and it does not add to their beauty. Wild cherries and peaches and gooseberries were not good to eat, but the wild strawberries found occasionally were excellent, and much larger than those found in China.

The villagers were all most friendly and extremely interested at seeing a European. As the caravan arrived they would troop out of the villages bowing and putting out their tongues, which has the reverse significance of what it has in Europe. They led the horses of General Pereira and his interpreter into the village, and the head man of the village bustled about to make things comfortable and to attend to the wants of the caravan.

The Tibetan houses are of mud and wattle, with uneven plank floors and log roofs which are not very waterproof. The windows occasionally have shutters, but have no paper to cover them as in China. Occasionally they are furnished with a low plank bed, stools, and rugs. When General Pereira availed himself of a room he always found it advisable to have the rugs removed. It was always a comfort to get a room instead of using a tent. There are no hens, and so eggs could not be got; milk was obtainable, but the cleanliness of the utensils in which it was kept was so doubtful that it was not sought after.

Chamdo was reached on July 28, and the whole town appeared to turn out to greet the caravan; at the stage before, General Pereira had been met by a Tibetan official to welcome him on behalf of the Siwala, the chief Tibetan official at Chamdo. Before reaching Chamdo the Ngom Chu was crossed by another fine bridge with five piers. Since entering Tibet the road had been well bridged.

It is about 260 miles from Jyekundo to Chamdo. On this journey they passed about six monasteries, all small except Rashi Gomba, and twenty-six villages of from one family to twenty-two families, but usually about six families. This is a main caravan route, and so it gives an idea of the small settled population. Of course the nomad population, with its need for good grazing, is more scattered, but the number of caravans met was quite small. A large English village would accommodate the total population met on this part of the journey, and if you scattered this population over the road between London and Newcastle, a similar distance, you would find the country a very lonely one, but as thickly populated as this part of Tibet.

Chamdo is on a little peninsula between two branches of the Mekong, in a valley surrounded by hills. When the Chinese ruled Tibet there were about three hundred families in the town and three thousand monks in the monastery, but during the fighting in 1912, when the Chinese were driven out, a great part of the town and most of the monastery were

destroyed. Now there are only one hundred and eighty families and very few Chinese and about four hundred monks in the monastery, part of which has been rebuilt.

Chamdo Province is governed by a lama with the title of Kalon Lama, and under him is a lesser official called the Siwala; a representative of the Dalai Lama, called the Drepon, commands the troops at Chamdo. Most of the troops had khaki jackets, and the words of command are in English, as they have a drill instructor who was trained at Darjeeling. More startling than hearing English words of command in this out-of-the-way place was to hear bagpipes; and at General Pereira's request one day the pipers played "Highland Laddie" very creditably.

General Pereira says that the tiny Tibetan children here are very jolly, dancing about and full of fun, but unluckily very dirty; the girls play shuttlecock, kicking it with their feet like the Chinese, and sometimes an expert will give a good exhibition, kicking it alternately with the front and back of the feet. Among the games played is stone-throwing to see who can throw the farthest.

The Tibetans are fond of flowers and have flowers in pots on their balconies; down by the river at Chamdo they have kitchen gardens with diminutive plots of cabbages, turnips, onions, and tobacco.

Whilst at Chamdo General Pereira's interpreter was taken ill and his face was covered with blotches; his Chinese boy said it must be smallpox, "t'ien-hua" or "heavenly flowers," as the Chinese call it, but it turned out to be a malady prevalent in this locality and not serious.

On September 3 a favourable reply was received from Lhasa to the letter sent from Tangar, and he started on the last section of the journey on September 6. The transport was eighteen "ula" yaks, or their equivalent, and a few riding horses.

For the first eight stages they followed the main Chamdo–Nagchuka road. Six weeks previously the Mekong had been exceptionally high, with rapid swollen waters, but now, though still a swift stream, the water had gone down a lot and the side streams were no longer fierce torrents. Two merchants, half-caste Chinese-Tibetans returning to Giamda, joined the caravan. The first day out from Chamdo they met a Tibetan woman carrying a letter from Lhasa from the Tsarong Shape, saying that General Pereira would be welcome at Lhasa and offering any assistance required, also stating that the telegraph at Lhasa was opened on August 3. An excellent English translation accompanied the letter. This friendly letter was indeed most welcome.

On September 7 some of the valleys were well wooded, chiefly spruce, and Namt'so La, 14,867 feet, was crossed after a very long and arduous climb. This range is not the Mekong–Salween divide. The natives all agree that the Dzer Chu joins the Mekong not far from Chamdo, though existing maps call it the Dzi Chu and generally show it as joining the Salween. Crossing the Namt'so La entailed a climb of 4000 feet, and

the long descent was by a track of large boulders or countless stones. The view from the top was over many ranges, some wooded, some bare. An 18-mile stage such as this at the high altitude called for considerable powers of endurance.

Ngemda was reached on September 8. Up to this General Pereira had at times followed for a short way or had crossed the routes of previous travellers—Major Bailey, Colonel Bower, Mr. Rockhill, Mr. Teichman, Colonel Kozloff and others. No European had been further west on this road since the journey of the Abbé Huc, although Mr. Coales of the English Consular Service had recently spent some time in Chamdo, and his excellent description of the town recently appeared in the Society's *Journal*.

The type of country was now entirely different from that of the earlier stages. Occasionally the valleys and hillsides were covered with spruce, maple, and acacia; sometimes they were grass-grown or covered with wild flowers, and the scenery was often very beautiful. At times the going was good, but often it was over very stony tracks. At Kama Sumdo there was a solitary house where the "ula" officials live, as there is no village for a long way and the "ula" has to be procured from the nomad tribes who are sometimes 20 or 30 miles away. Four young Tibetan girls making a pilgrimage to Lhasa joined the caravan here.

On September 10 there was a long stage of 24½ miles to Meru Tanda through uninhabited country among bare hills, over a very stony track with 8½ miles uphill to the top of the Mu La, 15,667 feet, the Salween-Mekong divide. Fresh "ula" which had come from 30 miles to the west was waiting here for the caravan. Only one house and a few tents were seen this day.

The stage on September 11 was 25 miles to Garmé. The Tibetans said it was an easy day, but it proved otherwise. The Tibetans are very good at geography, knowing the names of rivers and streams and where they flow; quite different from the Chinese, who are grossly ignorant and never know the name of a river. In Tibet the rivers do not change their names as they do in China; mountain ranges do, but the inhabitants know the names of the various sections.

The first 17 miles of the 25 was through almost uninhabited country. Five ridges were climbed, the highest and steepest being the Rab-che La, and they passed through high grass-covered hills, backed by rugged ranges. The last climb was over the Dung-re La, after going 15 miles; from it there was a beautiful view to the west down the Me-ru Valley, with three big monasteries high up on the hillside and many small villages down in the valley. Most of the hillsides and valleys were cultivated, and it looked more like China; it was the most fertile valley yet seen in Tibet. Forty miles W.N.W. there was a great snow-clad range called the Ture La running north and south, the only thoroughly snow-covered range yet seen with the exception of Amné Machin, and for a welcome change the hills

opened out to broader valleys. At Garmé, where they halted, there is a village of twenty-eight families and a garrison of two hundred and thirty soldiers, and it was strange at dusk to hear familiar English bugle-calls. The day's journey had been long and tiring.

Denchin was reached on September 13; a small village of twenty-three families, but an important place, as routes radiate from it north to Jyekundo, west to Nagchuka, and south to Shobando. It had been a fine warm day with hardly a cloud.

During his stay here General Pereira saw a specimen of Tibetan justice. Hearing the bugles sound the officers' call, he looked out of his window and saw a party of soldiers escorting an unfortunate lama to the outskirts of the village to undergo a sentence of having his right forefinger cut off. Later the soldiers returned headed by pipers playing "The Campbells are Coming," and behind them was the unhappy lama carried on a man's back. They sent round to General Pereira for medicine, and he provided boracic ointment and lint.

He had found the Tibetans a joyous race, always laughing but very servile. They always passed him anxiously, but if he nodded to them they beamed and put their tongues out. They have none of the tiresome Chinese etiquette, but they have an annoying habit of giving you presents and tipping your servants, all which generosity has to be returned.

General Pereira's stroll through the village of Denchin caused the greatest excitement, for all the inhabitants turned out and followed him, but not offensively like the Chinese. He described Denchin as being very prettily situated with lovely surroundings.

At Lachin, near the end of the next stage, he came upon many instances of stone posing, a favourite Buddhist devotion, presenting the most marvellous feats of equilibrium, sometimes with one stone, sometimes with three or four, and they seem to select the most impossible stones for this purpose. The same custom exists in China.

Forming piles of stones with prayer flags on the top is also a very prevalent custom. There is always a small one on the top of every pass, and it was these that General Pereira really appreciated, as they denoted the end of a generally arduous climb. Nearly every day there was some big pass to surmount with wonderful panoramic views from the top over bare, partially snow-covered hills in the distance, the lower hills generally covered with bush or fir trees.

Near the end of the stage on September 16, following a track along the hillside 800 feet above the valley, they got a wonderful view of the mighty Salween called in Tibet the Gia-mo-ngui Chu, coming in from the west, winding through a narrow valley between hills which rose 2000 feet above it. They had an extremely steep descent over stony and rocky ground to Zinda on the Salween, the height of which is 11,090 feet.

On September 17 they did 17 miles to Ru-a-tung, following the Salween all day, the path keeping mostly high up on the hillside, and at the end of the day's journey gradually descending to the river and across what for Tibet is a small plain with a monastery and about a dozen farms. They crossed the river by coracles, the horses swimming. The caravan had now crossed the Yangtze, Mekong, and Salween and various big tributaries and had forded the Yellow River and Yalung, and they were shortly approaching the basin of the Tsangpo or Brahmaputra. The Salween is full of fish, but the Tibetans, being Buddhists, do not catch them.

Shobando was reached on September 19; it is a comparatively large town of three hundred families, and there is a monastery of three hundred monks. The caravan, which up till now had been following a side route to Lhasa, joined the main route at Shobando, a dirty town with narrow winding streets, partly paved with big uneven cobbles. The houses are of mud and generally two-storied. The altitude of Shobando is 11,700 feet. There was a good variety of supplies here, turnips, lettuce, potatoes, eggs, butter, beef, and mutton.

From here on to Lhasa there are milestones called "melli"; the interval appears to be about 2000 paces.

Pien Ba was reached on September 23. It is the Pian Pa of Abbé Huc, who laughs at the Chinese for saying it is on the biggest plain in Inner Tibet, and says it is no plain at all; but General Pereira considered it the flattest piece of ground he had seen since leaving Jyekundo, though of course it does not compare with the great plains to the north.

On September 25 there was another hard stage of over 20 miles, over the Dor-ji La, 14,600 feet, as a preliminary to the Shiar-gung La. Following a snow-covered path they eventually came to a very steep ascent to the summit of the second pass. There were 2 or 3 inches of snow on the top and all the surrounding mountains were covered with snow, but as it had snowed two nights previously, it was impossible to tell if snow was normal up here or if all had fallen recently. There was a jumble of mountains all round, one towering peak to the south-west in shape like the Matterhorn, which must have been well over 18,000 feet

The Shiar-gung La is the Salween–Tsangpo divide and is reckoned the worst pass on the road. Abbé Huc, who calls it M. Tanda, crossed it at the worst season, and gives a very graphic account of the difficulties that he encountered. The height of the pass is 16,528 feet. The descent was steeper than the climb, and they soon got out of snow, but the route in many places lay over huge boulders and stones and it was a relief when they reached a beautiful gorge all covered with scrub, where they camped at 5.30 p.m. Fortunately it had been a bright sunny day.

Judging from Abbé Huc's account of the stage to A-la-ja-gung on September 27 General Pereira expected to find the path high up on

narrow ledges with yawning precipices below, but he found nothing alarming, and said that unless you were bent on committing suicide you could hardly fall off the path except in a few places; but the road was shocking, and General Pereira says it was the worst he had ever met in 40,000 or 50,000 miles of travel in the Far East. There were compensations in the magnificent scenery of the Nok Chu defile with hills rising 2000 feet up on either side covered with fir trees. Often the path lay through delightful woods and there were some waterfalls descending from a great height. During the next stage to A-la-dor-ta the deep abysses which Abbé Huc said abounded were not met with. They had a chilly camp at the end of the stage at a height of 15,200 feet.

September 29, 18 miles to Sa-chu-ka. General Pereira said in his diary that this was the very worst stage he had ever done, owing to the appalling going. They at first followed the well-wooded Nok Chu valley for several miles and then travelled between barren, stony hills over the boulders and rocks that had fallen and rolled down into the valley. It was a regular sea of boulders; they eventually crossed the Nur-gung La. Unfortunately spirits of wine ran out and so no more boiling-point altitudes could be taken, but the altitude of this pass by aneroid was 16,800 feet, the highest point yet reached. Abbé Huc called this pass the Chorku La.

On reaching more level ground the route passed the beautiful blue Serpentine Lake, the Tso-dung-wu-ngi, a mile long and 300 yards at its widest point. The camp that evening was at 14,800 feet near the hot springs mentioned by Abbé Huc; it had been warm and sunny during the day, but very cold in a tent at night.

On September 30 they had an easy stage to Lhari-guo through narrow, barren valleys and easy going, and only one hill to cross.

This place is marked Lharung Giachug on the Indian map, and is called Lhari by Abbé Huc. It is a poor village of fifty families and a monastery of sixty monks, but is important, as several routes radiate from it. After ten very strenuous days a rest was taken here, and General Pereira enjoyed the comfort of a nice clean room. The Chief Official called on General Pereira in his robe of state, bringing a supply of eggs and vegetables. Judging from what the official said, Abbé Huc did not exaggerate the terrors of the passes in winter when the Shiar-gung La is the worst and most difficult pass on the road, and he correctly describes how forty unladen yaks are driven ahead of a caravan to make a path through the deep snow. Merchants cannot afford this luxury, and it is usually only officials on the most pressing business who attempt the journey in winter.

On October 2 they crossed the Banda La, the Archa Pass of the Indian map, and Mount Lhari of Huc, whose height is 16,000 feet. It is the third highest pass on the road, with a final climb of fourteen zigzags to the top, which was extremely trying; though snow-covered, the path

was clear. In descending they soon got a view of the Adza Lake of a beautiful light blue in a valley surrounded by snow-covered mountains, the end of the valley being blocked by a range of 17,000 or 18,000 feet. Here they camped at 13,000 feet.

The following day their route lay below this range, and only a few nomads were seen. They camped at Guo-Le, where there were three stone hovels, and had an extremely cold night at a height of 14,450 feet. General Pereira was feeling weak from the great exertions of the steep climb, and walking was a great effort. On the other hand it was extremely cold riding, and it was always a choice of one of two evils whether to suffer from fatigue or cold. Abbé Huc related that there were unicorns here.

On October 4 the Tro La was crossed, 16,050 feet. This, the last of the four big passes, crosses the very high ground broken by deep valleys extending to east of the Shiar-gung La. There were some very steep zigzags and a final easy rise to the top of the pass, the last 500 or 600 feet rise being through snow. It had been cold at the start of the march, but in the camp at Giamda it was sunny and quite pleasant with a fur coat at 5 p.m.

Lara, 12,400 feet, was reached the next day, a village of twenty families. They saw from the road several square towers about 40 feet high. They were the defensive towers put up at the time when the Jungar Mongols, also known as the Eleuths, were powerful in the Koko Nor region. They invaded Tibet several times, and were finally crushed by the Chinese Emperor Chien Lung, who banished part of them to Chinese Turkestan, where a tract of country is still known as Jungaria, and General Pereira had met remains of this broken race whilst shooting in the Tien Shan.

Giamda was reached on October 6. It was a relief to be camped again at a lower altitude of 11,750; it had been a glorious sunny day and the scenery had been very beautiful, the evergreens mingled with the yellow and brown autumnal tints. A clear stream often ran parallel to their path, sometimes passing over rapids, and occasionally forming islands covered with trees, prominent among which were dwarf cedars, and a blue flower very common in Tibet.

Inner Tibet, with high mountains everywhere and its deep valleys, is a beautiful country in September and October. General Pereira had never seen country to surpass it for grandeur. At this time of year, except at great heights, it is as mild as an English autumn, with sun most days, and there had not been a drop of rain since leaving Chamdo. There was generally a frost at night.

Abbé Huc mentioned that there were two colossal temples at Giamda, but there is no sign of them now. He also mentions a colony of natives from Bhutan; General Pereira found two in the village.

Jinda was reached on October 8, and from here the road now ran due

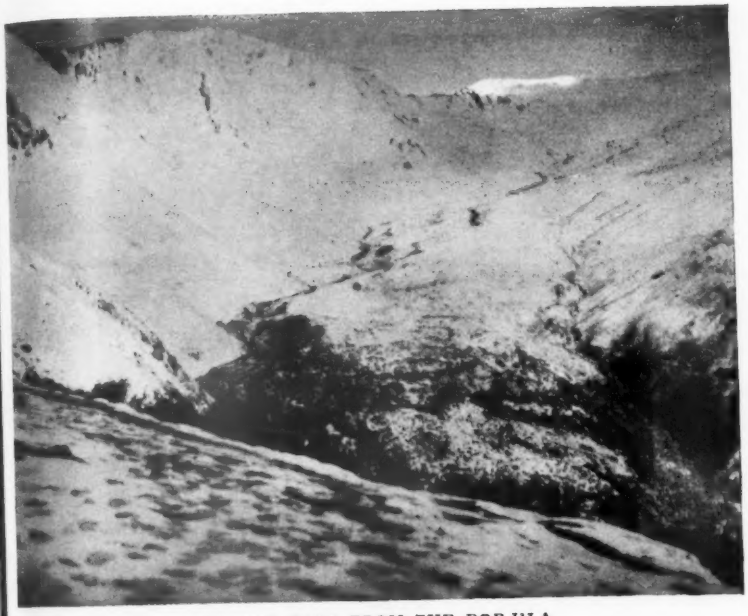
west to Lhasa with only one big climb ahead. Leaving Jinda they followed down the Siap Chu Valley, the river, 20 yards wide, flowing over a bed of boulders through a valley 300 to 500 yards wide. The hills were mostly covered with trees and bush, now very beautiful with their autumn colouring. The journey was now more enjoyable, chilly starting in the morning and then gloriously warm and through beautiful scenery, between hills rising 1500 to 2000 feet or more above the valley, at times passing through pleasant woods.

The last pass on the road was crossed on October 11, the Gung-bu-ba La, 15,300 feet, by far the easiest pass of the lot. Whilst going over the pass there was a bitter head wind and ice on the streams, but there was only a little snow on one or two of the hills. Abbé Huc described the crossing of the pass in winter as very difficult, "five days winding in a labyrinth of ravines and torrents." It is probable that the winter crossing made the configuration of the ground seem worse to Abbé Huc than it really is. The caravan halted at Ren-jin Ling, 14,800 feet. It was cold there, but General Pereira secured a room in one of the four hovels that comprise the village.

It was a great satisfaction to have no more passes to negotiate, and from here to Lhasa it was all downhill. Me-jo-kung-gar was reached on October 14. There was a great change in the country, and the route lay down a broad flat valley $\frac{3}{4}$ mile wide at the start and opening out to 2 miles, the flattest and most open bit of country seen since they were north of Jyekundo. The bordering hills were lower, rising 500 to 800 feet above the valley, grass and scrub covered, with practically no trees except a few round the villages, of dwarf cedar, and small evergreens along the banks of the river. Eight small villages were passed this day and some big, square, two-storied, flat-roofed houses of better class. The last of the barley crop was being gathered. The route followed the Shung Chu, which changes its name to M'e Chu, and later to Song-hu Chu; this change of name of the river seems different from General Pereira's experience in Eastern Tibet.

Three more stages following down the Song-pu Chu Valley and Lhasa was reached. The journey had been done in 37 stages from Chamdo, 670 miles, and the distance from Peking was 6360 miles, of which General Pereira had walked over 3500. He had successfully accomplished the big journey on which his heart had been set for many years, and his cablegram home, "LHASA, ENGLISHMAN FIRST," showed his pleasure that the credit of this journey should come to England.

General Pereira had a charming residence at Delinka, outside Lhasa, put at his disposal by the Tsarong Shape, the Commander-in-Chief of the Tibetan Forces, and he had an extremely interesting audience with the Dalai Lama. He met all the big Tibetan officials and four Rugby boys, Tibetans who had been educated in England, one of them a lama.



LOOKING EAST FROM THE DOR-JILA

LOOKING WEST DOWN ME CHU VALLEY

LOOKING WEST TO NGUI-CHOR-KE

LOOKING DOWN ON TSO-DÜNG-WU-NGI FROM THE NUR-GÜNG LA

After a short stay at Lhasa, General Pereira travelled to Calcutta, a part of the journey now so familiar that I will not refer to it. He reached Calcutta on November 23, and was carried off to a nursing hospital suffering from thrombosis, or clots of blood in the left leg brought on by the severe exertion of his journey. As soon as he was well he started off on 2 January 1923 on further arduous journeys.

In concluding my lecture I wish to explain that I was emboldened to undertake the task by the number of letters I received from friends of my brother who were anxious that an account of his travels should be published. These letters showed what great friendships he had formed. I have had them from all parts of China, from officials, missionaries, and civilians; and his friendships were not confined to Europeans, for his diaries constantly show the mutual trust and interest there was between him and many Chinese of high rank.

Also I wish to emphasize this point: the difficulties of carrying through such a journey as this are obvious, but General Pereira was over fifty-eight years old when he started on it. He was lamed in a hunting accident soon after joining the Grenadier Guards, the lasting effects of which would have deterred most people from undertaking arduous journeys on foot, and he suffered from the effects of frostbite incurred during his shooting expedition in the Mu'ping district. A will of iron and an unshakable determination to overcome all difficulties were the cause of his success.

Before the paper the PRESIDENT (the EARL OF RONALDSHAY) said: A certain melancholy attaches to our proceedings this evening, for the traveller of whose journey we are to have an account to-night is no longer alive to tell the tale himself. We are greatly indebted to Major-General Sir Cecil Pereira, the brother of the late Brig.-Gen. George Pereira, for compiling from his letters and diaries an account of his last great journey from Peking to Lhasa. It may be that the general public have up to the present time known little of the many journeys of the late General, but those who have had the advantage of reading his reports officially can testify to their great value, particularly from a geographical point of view. I am told that although the late traveller spent the greater part of the last two and a half years of his life in out-of-the-way places, his brother never once during the whole of that time failed to receive a regular mail from him. Sir Cecil Pereira is well qualified, therefore, to give us an account this evening of that great journey from China to the heart of Tibet which in its entirety has not been performed by a European since the days of the Lazarist missionaries, Gabet and Huc. I now have much pleasure in calling upon General Sir Cecil Pereira to give us his account of the journey.

Major-General Sir Cecil Pereira then read the paper printed above, and a discussion followed.

The PRESIDENT: We are fortunate in having with us this evening General Anderson, who has travelled with General Pereira in former days. I will ask him to add a few words.

Brig.-General ABBOT ANDERSON: It was my great privilege in 1911, on leaving the Legation Guard at Peking, to accompany Brig.-General Pereira

on a trip for shooting and exploring in the Altai and Tien Shan. We were together for nine months on this journey. Starting from Peking, we went to Omsk by the Siberian Railway, and from there *vid* Semipalatinsk, travelling up the River Irtish for fourteen days in shallow-draft steamers to the Russian outpost of Zaissan. I need not weary you with details, but in nine months one gets to know a man pretty well. I had previously seen a great deal of Brig.-General Pereira when he was our Military Attaché in Peking, and I can only say that from what I knew of him I am not the least surprised that he succeeded in this great effort of travel from Peking to Lhasa, for a man with more grit (he was lame, as Major-General Pereira has told us) I have never met. He had travelled all over China, and had been in every province there; but the amount of work he had done and the reports he had sent in are known to very few. I only wish, judging from a letter I had from him last year, that he had been able personally to tell us of his journeys and to have given us the interesting lecture which we have listened to to-night.

The PRESIDENT: The account of the journey which we have heard to-night recalls another great journey which was made from Peking to India many years ago by an ex-President of this Society, Sir Francis Younghusband. I will ask him to address the meeting.

Colonel SIR FRANCIS YOUNGHUSBAND: As one who has travelled both in China and Tibet, I should like to take this opportunity of expressing my high opinion of that fine achievement the record of which we have listened to. We are impressed by the grit and determination which General Pereira showed, and it is all the more remarkable that at the time he made that journey, travelling 3500 miles on foot, he was a lame man and had been lame for many years. That, as General Anderson has said, emphasizes his grit and determination. But to me it seems that the most valuable result of his journey is the good impression which he left behind. He had to find his way through China at a time of civil warfare when one province was at war with another, and when the whole country was overrun with brigands; and it stands to reason that no man travelling by himself, as General Pereira did, could have got through if he had not possessed in a high degree the capacity of getting on with the peoples, both high and low, whom he met. That evidently was the case with General Pereira. With high Chinese officials, with high Tibetan officials, and, I should gather also, with high British officials he was able to find his way. The result was not only a feat of great physical endurance, but the gathering of much valuable geographical information as well, with maps and photographs. Probably the most striking geographical feature which he met with on his journey was that high mountain which the exuberance of some journalist in Calcutta put higher than Mount Everest. When we read of that in the papers we made allowances for the optimism of journalists. Knowing General Pereira we knew that he would not have committed himself to such a statement unless he had very good foundation for it. It is not likely that a mountain over 29,000 feet would stand up by itself without some other very high mountains as satellites by it. Mount Everest itself does stand head and shoulders over the other mountains round; all the same there are peaks of 26,000 feet and 27,000 feet close by, and so it was not likely that anything higher than Mount Everest would stand out without being accompanied by satellites something like it in height, and we do not hear of any considerable cluster of peaks. But from the good impression which General Pereira left behind, we hope it may be possible for some future expedition to go out there and measure the exact height of that mountain, and probably it will be in the order of 25,000 feet, as General Pereira has surmised.

It was very fortunate for General Pereira that he had the good-will of the Tsarong Shape, the Commander-in-Chief of the Tibetan Forces. Evidently the attitude of the Tibetan Commander-in-Chief has changed since I was in Tibet twenty years ago. The commander at that time said that as a rule he did not eat meat, but he would be exceedingly glad to eat the flesh of us Englishmen. That was his attitude in this very month twenty years ago, when he was with 8000 men engaged in besieging us in a small farmhouse, whilst we had only 500. So that there is a considerable change for the better now—though perhaps not entirely for the better, for we have heard of the advent of bagpipes into Tibet, and about "The Campbells are Coming." The Campbells did come when I was at Lhasa. The colonel of one of the regiments of the escort was Colonel Campbell, who lived in the same house with me at Lhasa, and he had bagpipes playing all day long and most of the night as well.

I am glad to have heard the many references in the lecture to the French travellers Gabet and Huc. Theirs was really a very remarkable journey. I asked the Regent with whom I was negotiating whether any Europeans had been there before us. He said he could quite well recall when he was a small boy having pointed out to him two Europeans walking through the streets of Lhasa. From the dates which he gave it was evident that they were Huc and Gabet. All that General Pereira has said confirms the good work which those pioneer missionaries did in Tibet.

Major-General H. R. DAVIES: I will not detain you long at this late hour, though I am very glad to respond to the call of the President, because of the great admiration that I have felt for General George Pereira, both as a man and a traveller, during many years' friendship. I know there are a few people who realize the important work that he did even before his great journey to Lhasa, but so modest was he and so averse to putting himself forward in any way as a great traveller, that I think there were many to whom his name may hardly have been known when the news came through that an Englishman had arrived in Lhasa from the East. It was a great feat. Many had tried before, but no previous traveller had succeeded since the 'forties of the last century. I think also the great work that he did previously should not be lost sight of. He had, I believe, travelled between 40,000 and 50,000 miles in the Chinese Empire. He had visited every province and every part of every province, and he had not only travelled in China proper but in Mongolia, Manchuria, Chinese Turkestan, and Tibet.

I may say without any fear of exaggeration that no European who ever lived has made such extensive journeys in the Chinese Empire, and I may also add that I do not believe that any Chinese has ever had such a great geographical knowledge of his own country as General Pereira had of China. The President has alluded to General Pereira's great thoroughness. I have had the opportunity of seeing many of his reports, and know how true that remark is. No more thorough observer ever travelled in China.

Those who did not know him might imagine that he was a very robust man who felt no fatigue and could stand any climate. But this was by no means the case. He was not a very strong man. It was not bodily strength that carried him through; it was the great spirit within. His great heart carried him through all obstacles and all physical disabilities. I do not think there is any better example of this than what happened when he arrived in Calcutta. He was suffering, as the lecturer has told us, from clots of blood in the leg, was fifty-eight years of age, and had just done a journey that no European had done for eighty years. A less resolute traveller might well have

been content to say that this was sufficient, and go home ; but this was not his way. He had determined that he would do other travels in China, and knowing full well the risk of his leg breaking down, he started off again into one of the most mountainous provinces.

One more qualification I have for speaking of General Pereira here to-night, and that is that during the war he was at one time commanding a battalion in the brigade that I then had. I need hardly say to any one who knew him that the more dangerous the position he found himself in the better he was pleased. He was a great example of courage and enterprise to all those who served under him. I feel we have lost not only a very great traveller but a very gallant soldier.

The PRESIDENT : At this hour of the night I do not propose to add anything to the discussion which has taken place on the paper. I merely desire, on your behalf, to express to our lecturer our sense of admiration, both for the character and for the achievements of his late lamented brother, and to the lecturer himself the sense of our gratitude for the manner in which he has compiled from the traveller's letters and diaries so admirable and accurate an account of his brother's great journey. Finally, we assure him that after listening to his description of that journey we shall all look forward with the greatest interest to the more detailed account in the publication which he has foreshadowed.

THE PROPOSED ADOPTION OF A STANDARD FIGURE OF THE EARTH

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Read at the Afternoon Meeting of the Society 12 *May* 1924

THE question here propounded for discussion has first to be stated in terms of scientific precision. On the Earth there are many obstacles militating against precise definition: mathematical uniformity is not to be expected in the phenomena of Nature. In considering the dimensions of the Earth it is essential to fix on some kind of regular surface; what is the surface to be adopted?

At the outset we are faced with (1) the *actual* surface of the Earth with all its irregularities; obviously it would be impossible to speak in precise general terms of the dimensions of the actual surface. There is (2) the surface of M.S.L., such as would be apparent to the eye were it possible for the ocean to interpenetrate the land through frictionless canals of great capacity. This surface is known as the *geoid*. There is (3) a surface described as the *ideal*, being the external form of an earth in a state of permanent hydrostatic equilibrium. Finally, there is (4) the *geodetic* surface with which we are chiefly concerned at the moment.

The geoid may be popularly described as the surface to which the plumb-line is everywhere perpendicular. It is found to be of irregular curvature within the continents, and it is fairly certain that the curvature of the oceans themselves is not quite regular. The surveyor is directly interested in the geoid—an equipotential surface on which he works

perforce; or more correctly, he works at each station on a surface which is very nearly parallel to the geoid. Comparatively large changes in the vertical produce small variations only in the height of the geoidal surface.

Unfortunately, in general the local form of the geoid is unknown and the adoption of a generalized form is obligatory in common practice, even in operations of the highest order. It is known that the generalized form of the geoid is an oblate spheroid to a close approximation; no later discovery has upset the Newtonian figure. The geodetic surface may now be defined: it is that ellipsoid of revolution which most nearly fits the geoid and whose minor axis is coincident with the best known mean position of the Earth's axis.

2. Fixing thus on a certain shape is not an absolute necessity: it is rather a necessary convenience. Points on the Earth's surface could be referred to three coordinate planes, and are so referred for certain mathematical purposes. But the works of mankind, and in particular those of the geodesist, surveyor, astronomer, geographer, and navigator, are executed on the terrestrial surface; and in general practice it would be excessively inconvenient were any attempt made, by the adoption of planes of reference other than the local plane of the superficies, to ignore this fundamental condition.

It has been sometimes considered that the shape of the Earth approximates more closely to an ellipsoid of three unequal axes, and such a form has been shown to be not inconsistent with certain conditions of equilibrium in a rotating body; but this form has never been established satisfactorily, and in any case the two equatorial axes are so nearly equal that the spheroidal form is quite sufficient as a figure of reference.

The spheroid is otherwise satisfactory as a mathematical figure of reference, for although the arcs involve elliptic functions, the figure is nevertheless sufficiently simple to yield in general to comparatively simple treatment; it presents to practical working no difficulty of much greater moment than is found in the corresponding relations on the sphere. Once the necessary tables are computed, the operations are in general practice easy.

3. As knowledge grows, older views may require modification. This condition has now been reached by reason of the number of determinations of the dimensions of the Earth which have been made in comparatively recent times. It is known that none of the spheroids in common use are in harmony with the facts. Differences of the full order of 1000 metres are existent in the lengths of the major semi-axes of these spheroids, although it may now be said definitely that the length of the semi-axis is known to the order of 100 metres. Similarly the reciprocal of the compression (flattening or ellipticity) shows a variation of 7, whereas in the light of present knowledge the variation should be little, if any, greater than unity.

The international worker is handicapped by so much diversity in practice, and the mind naturally revolts at anachronism and hopes for greater uniformity. It is to be regretted however that the argument for standardization is affected by very practical considerations. Vast areas have been projected on the old spheroids, and conversion involves labour of no mean order of magnitude; in some cases it implies some years of computation. Further, in most cases there are some essential factors to be considered and probably a large amount of observation carried out before any permanent conversion can be even initiated.

These facts must not obscure the desirability for standardization. The present diversity impedes reference, increases labour, and is a positive drawback to both practical and scientific investigation. Moreover, in many countries surveys are not sufficiently advanced to render conversion to a standard system laborious; in others, survey has been barely more than begun; while in the greater areas the conversion to a standard system can be deferred until the time is ripe for action. Further, until a general agreement has been reached, countries which are hesitating as to the desirability of proposing a change are not likely to make any immediate move; and if an accepted system is before all eyes, there is no doubt that progress towards conversion will be greatly accelerated.

4. The spheroids in most general use are those of Bessel (1841), Clarke (1880 and 1866), and Everest (1830). It is commonly, if not universally, agreed that the compression of the Everest and Bessel is too small and that of the Clarke (1880) too great. The Everest and Bessel semi-axes are too small, and even those of the Clarke spheroids are also rather small.

Besides these figures several others are in national use. The following list is not exhaustive: the spheroid of the *Carte de France* (1820) in France and Belgium; the Plessis spheroid reconstituted by Puissant (1830) in France; the Walbeck (1819) in Poland; the Airy (1837) in the United Kingdom; the Clarke (1858) in the British Colonies; and the Helmert–Hayford quite recently introduced in Finland.

It must be understood that the present discussion does no more than approach the subject on broad lines, and that even in the light of present knowledge no more is possible here than a discussion on such lines.

It is now customary to define a spheroid in terms of the major axis (a) and the compression or flattening (f), the latter being $(a - b)/a$, where b is the minor semi-axis.

5. The major semi-axis can be obtained from:

i. Geodetic measurement.

ii. The lunar parallax in conjunction with the intensity of gravity.

Since ii. is apparently not capable of refinement, it will not be mentioned further here.

The compression can also be obtained from geodetic measures, but may be reached independently by several additional methods.

iii. Through the lunisolar precession and the "mechanical compression."

iv. By observations with the pendulum.

v. Through certain inequalities in the moon's motion due to the protuberance of mass along the terrestrial equator.

vi. By direct observation of the lunar parallax at points in the northern and southern hemispheres.

6. **Geodetic Measurement.**—There exists in the world to-day a vast amount of triangulation of the "First Order." But this term is relative and represents work of very variable quality. Thus, for example, the old triangulation of the first order in France is of much less accuracy than the new.

Of all this work a proportion only has been utilized for the computation of the Earth's figure. There are in the following countries more or less modern chains or nets of triangulation which have not been employed for this object: Norway, Holland, France, Germany, the old Austro-Hungarian Empire, Switzerland, Italy, Spain and Portugal, Algeria and Tunisia, Egypt, India, and Burma, Java and Sumatra, Japan, Canada, Mexico, Chile, New South Wales, Queensland, and New Zealand; a few of these might prove to be not utilizable. In other regions, such as Spitsbergen, Sweden, Peru, Uganda, and Northern Rhodesia, the measures are not yet complete or have not been published. In some, like Canada, work is still in progress. The failure to utilize all this body of material is not surprising if it be realized that the labour of incorporating all in a comprehensive investigation would consume great part of a lifetime.

The subjoined list contains the constants of the spheroids which have resulted from "Arcs" utilized hitherto. These arcs are either chains along a meridian (M) or a parallel (P); in the case of the United States, where chains of both meridian and parallel are available, the arcs are described as mixed. The list contains the greater arcs only; the smaller arcs would have little effect in the general mean.

No.	*Arc.*	*Mean lat.*	*1/f.*	*a(metres).*	*m.s.e.*
1	English–French–Spanish M. ...	49°·7	295·6	6,378,198	
2	Scandinavian–Russian M.	58°·0	294·2	330	± 115
3	Indian M.	18°·8	296·0	202	
4	European parallel of 52°	52°	299·15	057	± 105
5	Indian parallel of 24°	24°	298·3	358	± 182
6	South African M.	25°	298·3	307	± 179
7	United States (Mixed)	38°	297·0	388	± 53
8	European parallel of 47½°	47°·5	299·15	6,377,350	± 650

From these the last (No. 8), the parallel from Brest to Astrakhan, will be omitted since it i distinctly discordant and has an excessive error.

The first three are from computations by Pratt, who first endeavoured to take local attraction into the reckoning. The values of a average about 6 metres less than those of the Clarke (1880),—an amount of

little significance here; but the compression is much more in accordance with Clarke's 1866 figure, used in the North American continent. Other determinations, not in general greatly different, have been made from these arcs.

The European parallel of 52°, running from Valentia to Orsk, was very carefully computed at the Prussian Geodetic Institute with the Bessel compression. The Indian parallel and the South African meridian of 30° E. were also worked up in Germany with the value of the compression deduced by Helmert in 1901 from pendulum observations. It is an objection against these results that they do not give the compression peculiar to the arcs themselves or at least in sympathy with them.

In the United States the arcs of meridian, the Eastern Oblique Arc and the Arc of Parallel 39° have all been combined in a single determination based on the isostatic hypothesis.

In the endeavour to deduce a weighted mean from these results, the length, nature and position of these arcs should be taken into the reckoning as well as the estimated errors, since experience proves that the latter are by no means perfect guides. In this matter individual views are certain to vary: one must endeavour to preserve a perfectly open mind.

By the method of least squares the mean value of the major semi-axis and the reciprocal of the compression could thus be derived with ease. The solution, however, would convey little of an instructive nature; moreover the assumption of a compression in Nos. 4, 5 and 6 rather vitiates the result. It is much better to study the effects of change of the compression on the assumption that the curvature (on the meridian, the parallel, or in both directions as the case may be) is preserved at the middle of the arc. Since practically all modern opinion holds that the compression lies between 1/295 and 1/298, it is unnecessary to extend these limits. The following table shows the results of these conversions:

No.	*Arc.*	*Weight.*	$f = 1/295$	$f = 1/296$	$f = 1/297$	$f = 1/298$
			6378	6378	6378	6378
1	Anglo-Gallic M.	7	211	191	172	154
2	Russian M.	8	339	351	362	374
3	Indian M.	7	326	202	079	*957
4	European P. 52°	8	*871	*916	*961	006
5	Indian P.	6	318	331	343	354
6	South African M.	6	657	550	444	339
7	U.S. Mixed	20	423	405	388	371
—	Weighted Means of all arcs ...	62	318	295	271	248
		—	± 83·5	± 72·4	± 66·5	± 67·0
—	Weighted Means excl. Nos. 4 and 6	48	351	326	301	277
		—	± 36·3	± 43·6	± 58·3	± 76·0

The means and mean square errors reveal fairly well the range of doubt. The omission of the somewhat discordant values in Nos. 4 and 6 changes the means by about 30 metres. The mean square errors are no

more than rough indicators of the order of the error; the fact that they change their incidence when two arcs are excluded is symptomatic.

Taking all the results together we appear to see that any attempt to assign a particular dekametre to the semi-axis would be unjustifiable in view of residual doubts; the true value appears to lie between 6,378,250 and 6,378,350. It seems then that the figures 6,378,300 metres ± 50 represent as close an approximation to the true value of the major semi-axis and to the possible error of this result as we are at present justified in supposing.

It may be remarked that whereas Helmert about 1905 thought that the best approximation was 6,378,200 metres, by 1915 he had raised the figures to 6,378,350—a big and sudden increase. It may also be mentioned that Wellisch quite recently has arrived at 6,378,272 on a compression of 1/297, practically the same as one of the means in the table; one must however avoid captivation by coincidence.

7. **The Compression from Geodetic Measures.**—Before leaving this table we should note that some of the arcs lead to spheroids which are very sensitive to a change of the compression. This fact should serve as a warning of the danger of computing spheroids on adventitious values of the compression for which the arcs are unsuitable.

Conversely, a comparatively large change in the length of the axis has in these cases a small effect on the compression. Change in the compression in fact produces variations in the length of the semi-axis which for (1) meridional, (2) longitudinal, and (3) mixed arcs are proportional to the following functions of the mean latitude ϕ:

$$(1)\ -\tfrac{1}{3}(1 + 3\cos 2\phi);\quad (2)\ +\sin^2\phi;\quad (3)\ -\cos 2\phi.$$

Let us now find the values of the compression which correspond to a major semi-axis of 6,378,300, and let us weight these values according to the functions (1), (2), (3) above. The results are as hereunder. The European Arc of Parallel 52° is omitted as leading to a value which is very discordant.

No.	*Arc.*	*Weight.*	*1/f.*
1	Anglo-Gallic M.	3	290·2
2	Russian M.	2	291·6
3	Indian M.	17	295·2
5	Indian P.	2	293·5
6	South African M.	15	298·4
7	U.S. Mixed	3	302·1

The weighted mean and the mean square error are:

$$296{\cdot}2 \pm 1{\cdot}3.$$

It appears then that the greater arcs which have been measured in the various countries of the world suggest that the nearest approach which can be made to the major semi-axis is 6,378,300 ± 50 metres, and to the compression is 1/296 ± 1·5. They suggest, further, that any

attempt to assign the values to a closer approximation than round figures is not even yet justifiable.

8. **The Compression derived from the Lunisolar Precession, etc.**—By the aid of the theoretical discoveries of Clairaut, Maclaurin, D'Alembert, Laplace and Stokes, the ellipticity can be found from the mechanical compression, the lunisolar precession and the moon's mass, provided that some assumption is made with regard to the variation of density in the body of the Earth. This method has been followed by Callandreau, Darwin, Véronnet and de Sitter in quite recent investigations; we shall give the figures reached by the latter, who has recomputed the previous results.

The mechanical compression J is found through the constant of attraction in terms of the ellipticity by expressing the condition that the geoid to which the geodetic surface is the nearest approximation is the equipotential surface corresponding to the three moments, A, B, C, of the Earth's inertia involved in J, thus: $J = 3[C - \frac{1}{2}(A + B)]/2Ma^2$, M being the Earth's mass and $A = B$, at least to a first approximation. A quantity m is required in Clairaut's theory; this expresses the ratio of centrifugal force to the Earth's attraction, and is found from an expression for the latter rather long for inclusion here. $m = 0{\cdot}0034496$; whence $J = f - \frac{1}{2}m - 0{\cdot}0000039 = f - 0{\cdot}0017287$, a value which must be very nearly exact. The decimal with five zeros is a second-order term.

Another constant H is required to express simply the difference of the moments of inertia; this is $(C - A)/C$, where A is taken as the mean of A and B if there be any difference between them.

Now the ratio $J/H = 3C/2Ma^2$ can be found in terms of J itself and the ellipticity, if some law as to the distribution of density in the Earth is assumed and if it is remembered that the results apply to the ideal surface only. Laplace assumed a law of density, but Darwin has employed Roche's law. Since then J is obtained in terms of both f and H, by elimination f is obtained in terms of H and the law of density. If then H can be found, f is known.

Determination of H depends on the lunisolar precession and the moon's mass. Three values by Hough and Halm, Boss, Dyson and Thackeray have recently appeared for the Precessional Constant: $50''{\cdot}2486$, $\cdot 2511$, $\cdot 2503$, with a mean of $\cdot 2500$. Hence the lunisolar precession is $p = 50''{\cdot}373$ to a very high order of accuracy. Darwin remarks moreover that the Precessional Constant is very little affected by the law of density and depends almost wholly on surface form. The moon's mass μ in terms of the Earth's mass is taken as $1/81{\cdot}50 \pm 0{\cdot}07$; Hinks' value is $1/81{\cdot}53$, compared with Newcomb, $1/81{\cdot}45 \pm 0{\cdot}22$, and Gill, $1/81{\cdot}72 \pm 0{\cdot}18$; the doubt as to the exact figure is the chief valid argument against the precision of this method. Thus H is found to be: $0{\cdot}0032775 \pm 0{\cdot}0000022$. Finally Darwin derived $f = 1/296{\cdot}4$. This however demands reduction from the ideal to the geodetic surface, effected

by aid of the theory of isostasy; it is well to remember that the maximum difference in the dimensions of the two surfaces is of the order of 5 metres only. Thus de Sitter finds $f = 1/295{\cdot}98 \pm 0{\cdot}2$.

The effect of the assumption as to the density has been considered by Véronnet, who determined the bounds within which the ellipticity can vary on two limiting assumptions: (1) that the Earth is homogeneous, (2) that the mass is wholly concentrated at the centre. The results come out at (1) $1/295{\cdot}78$ and (2) $1/296{\cdot}62$, the former being of course nearer to the truth. The results afford very strong confirmation of Darwin's value as modified. Jeffreys has investigated another form of discontinuity, such as would arise were Wiechert's hypothesis accepted; but in general it may be said that Clairaut's theory is not incompatible with discontinuity. Darwin remarks that the ellipticity found in this way is perhaps as little in error as by any other method.

The doubt as to the moon's mass will remain until the next opposition of Eros, when it is hoped that a satisfactory programme of observation will be carried through successfully. Meanwhile the error in the moon's mass affects the compression thus: $\Delta f^{-1} = -2\Delta\mu^{-1}$ approximately; so that if the moon's mass were subsequently found to be $1/81{\cdot}6$, the compression would be $1/295{\cdot}8$.

In this method the compression is dependent on consequences which pertain to the whole Earth; not as in geodetic measurement, where the investigation is necessarily limited to a number of arcs covering a small part of the surface. The same remark applies also to the next method.

9. **The Compression derived from the Intensity of Gravity.**—This method has been very fully exploited by Helmert. His last investigation includes 410 inland stations, of which 171 are in Europe, 123 in Asia, 24 in Africa, and 92 in North America. These were selected as being neither on littoral nor mountain; but he includes also 325 coastal stations which were collectively given half weight. The inland stations gave equatorial gravity as $978{\cdot}037$ and the coastal $978{\cdot}079$. From the mean of all, thus weighted, the following formula was reached:

$$g = 978{\cdot}052(1 + 0{\cdot}005285 \sin^2\phi - 0{\cdot}000007 \sin^2 2\phi);$$

whence the mean value of gravity is $979{\cdot}771$ dynes.

The second term of this expression involves the compression thus: $2m - f + 0{\cdot}0000269 = 0{\cdot}005285$. Using the values previously given for m and f, we find $f = 1/296{\cdot}75$. Helmert's value is $1/296{\cdot}7$, which, he remarks, is in satisfactory agreement with the $1/296$ previously found; its mean square error is $\pm 0{\cdot}6$.

Accordingly, of the three independent determinations of the compression so far described, the values are $1/296{\cdot}2 \pm 1{\cdot}3$, $1/296{\cdot}0 \pm 0{\cdot}4$ (say) and $1/296{\cdot}7 \pm 0{\cdot}6$, all in very fair accordance.

The last value of the compression deduced by Bowie from measures of the intensity of gravity in North America is $1/297{\cdot}4 \pm 1{\cdot}5$; this value is in sympathy with the figures derived from the geodetic measures in the

United States. The curvature would thus appear to be somewhat less in the States than in the world at large.

Although the remaining methods of reaching the compression are of less importance at present, with growing knowledge they may have greater worth in the future. Brief references therefore will not be out of place.

10. **Compression derived from Inequalities in the Moon's Motion.**—Various inequalities in the lunar motion are attributable to the figures of the Earth and the moon. Brown has used for the present purpose the motions of the perigee and the node of the lunar orbit. From the residual motions after the main effects have been removed, together with certain assumptions as to the constitution of the moon, he finds that the compression is $1/293{\cdot}5 \pm 0{\cdot}5$, figures to which he attaches considerable weight. De Sitter, following the same method, concludes that the compression cannot be appreciably less than $1/296$ if the motion of the node is accepted, unless we are to attach an impossible constitution to the moon.

Other inequalities in the moon's motion are exhibited by the latitude and longitude. The inequality $\Delta\lambda$ in latitude can be obtained with the greater accuracy.

The formula given by Tisserand for the influence of the compression on the latitude of the moon is: $\frac{2}{3} \times 7439'' J \sin L$, where J is as before the mechanical compression and L is the mean longitude of the moon. Tisserand using Hansen's figures finds that cosec $L.\Delta\lambda$ is $-8''{\cdot}382 + 0''{\cdot}240 = -8''{\cdot}142$, in which the small term is that due to planetary disturbance. Taking de Sitter's value of J thus: $J = f - 0{\cdot}0017287$, we find $f = 1/296{\cdot}6$, the value given by Eggert. The latter shows that an increase of $0''{\cdot}1$ in the constant $8''{\cdot}152$ causes a decrease of $1{\cdot}8$ in the reciprocal of the compression. This method would appear worthy of a new computation with the more recent values of the inequalities which have appeared since the date of the lunar theory of Hansen, who had himself reached a compression of $1/296$ in 1865.

11. **The Compression from Observation of the Lunar Parallax.**—The theoretical value of the constant of the lunar parallax is expressible in terms of corrections to adopted values of the moon's mass, the mean intensity of gravity, and the compression. Comparing the values actually observed at the observatories of Greenwich and the Cape, Crommelin has given figures which lead to the parallax in terms of the compression. On the assumption that the mass of the moon and the mean intensity of gravity are known precisely, comparison of the theoretical and the observed values of the parallax gives immediately the compression.

$$\pi' \text{ (theoretical)} = 3422''{\cdot}525 - 0''{\cdot}013\Delta(1/f) + 0''{\cdot}172\Delta(1/\mu) - 1''{\cdot}16\Delta g_1$$

where $1/f = 296$, $1/\mu = 81{\cdot}5$, and $g_1 = 979{\cdot}771$.

$$\pi' \text{ (observed)} = 3422''{\cdot}42 - 0''{\cdot}059\Delta(1/f)$$

Neglecting the corrections to the moon's mass and to the mean value

of gravity, we find $f = 1/293{\cdot}7$. If however we put $\Delta(1/\mu) = -\frac{1}{2}\Delta(1/f)$ and $\Delta g_1 = +0{\cdot}0037 \times \Delta(1/f)$, we find $f = 1/298{\cdot}4$. These values are at least interesting as showing that in this way also a value of the compression may be obtained which is not far removed from the true value.

Owing to systematic errors of pointing on a selected lunar feature, it is doubtful if even a concurrence of continued observation at various observatories would eliminate the elements of indetermination.

Nothing in these later results modifies the view that the reciprocal of the compression may be taken as 296, with an assurance, in view of the accordance of the first three results, that the error will not exceed unity in either direction.

In conclusion, it appears that no better value than 6,378,300 metres is yet known for the length of the major semi-axis; similarly 1/296 represents the best approximation to the value of the compression which is justified by the present state of knowledge of our globe.

Before the paper the PRESIDENT (the EARL OF RONALDSHAY) said: Very few words are required from me to explain the circumstances in which the paper which we are to have this afternoon is being given. At a meeting of the International Union of Geodesy and Geophysics, which was held in Rome in 1922, a proposal was put forward for the selection of a standard figure upon which all future geodetic work should be based and to which as time went on all past work should be reduced. No decision was come to in 1922, but the Executive Committee were charged with the duty of considering the matter with a view to making a recommendation at the next meeting of the Union, which will take place at Madrid some time during the coming autumn. It seemed to us that it might be of considerable value if we were to have a discussion upon this subject here, and searching round for some one who would be capable of laying the question intelligibly before this meeting we were fortunate in finding Captain McCaw. Captain McCaw's experience of work of this kind is wide. He was engaged upon the work of the triangulation in South Africa under Sir David Gill and Sir William Morris. Later he was serving with Colonel Jack on the Uganda–Congo Boundary Commission. He carried out the triangulation in Fiji, and during the war he was serving with the Map Department at General Headquarters in the field. Since then he has been retained by the Geographical Section of the General Staff in a technical capacity. No one probably could be better qualified therefore to lay this subject before us than he is, and I will now ask Captain McCaw if he will address us.

Captain McCaw then read the paper printed above, and a discussion followed.

The PRESIDENT: I will now ask Mr. Hinks to make a contribution to the discussion. Mr. Hinks is well entitled to express views on this subject, and the meeting will, I am sure, be much interested to hear what he thinks.

Mr. HINKS: Captain McCaw has demonstrated very clearly that, so far as we can tell, none of the four or five figures of the Earth in modern use is correct within the limits he assigns to our present uncertainty. But we are not yet able to say what would be the result of including in one general solution all the work of the last forty-five years. There has been no compre-

hensive discussion since Clarke published his 1880 figure. A great deal of work has been completed and published since then, notably in the United States and South Africa; and there is a great deal more "all done but the finishing," such as the new French "arc de Perou," the Russo–Swedish arc in Spitsbergen, and the Uganda–Congo arc. Is the time opportune for adopting a standard figure of the Earth?

Such a question may be asked at any stage in Geodetic history. But such a question did not trouble those eminent French savants who established the metric system upon the dimensions of the Earth. They did the best they could at the time to determine the length of a quadrant of the meridian, and to make the metre a ten-millionth part of it; and though we know now that they were rather seriously wrong, and that their error was something like 1 in 5000, we must admit, I think, that they did well in going ahead as they did, and that the error in their result has produced singularly little inconvenience. Without wishing to force the analogy too far, I think we may argue likewise that the general adoption of some standard figure of the Earth will be a valuable thing, and that so long as we can agree upon some one figure, it is really a matter of convenience and practical politics, rather than of refined theoretical considerations, what figure we do adopt.

May I, however, before developing this side of the question, refer for a moment to one matter of general principle? In my youth, when I was an astronomer, I was much concerned with determining the solar parallax—the distance of the sun from the Earth—which can, like the flattening of the Earth, be determined in one direct way, by straightforward trigonometrical processes, and by several indirect ways, dynamical or physical. I used to maintain then that the direct process was the only right one: that if the indirect processes gave the same result, so much the better; it was an interesting verification of the mutual accord of many physical principles: but if they did not, no combination of indirect results should be allowed to overthrow the results of direct measurement. I would say the same of the indirect methods of determining the figure of the Earth. Captain McCaw has quoted my determination of the mass of the Moon (a bye-product of the parallax work) leading to what is called the mechanical ellipticity of the Earth. It is quite a pretty and amusing way of determining the flattening, and it comes somewhere near right. But I do not myself consider that this or any other indirect method stands high in comparison with the well-established direct method by the measurement of meridional and longitudinal arcs. I admit that it would be different if we had not now the assurance, due in particular to Mr. Hayford, that a happy condition of isostasy in the Earth's crust has saved the older work from being vitiated to any grave extent by topographical deflections of gravity.

To revert now to the question, what figure shall we adopt as standard? My position to-day is purely opportunist. I submit that at this juncture geodesists should agree to adopt as a standard one of the figures already in extended use, and that the choice should be governed largely by practical questions of convenience. I would exclude Airy's, Everest's, and Bessel's figures as being too far from the truth, and Clarke's of 1858 as not used in any geodetic operations of the first class (though widely employed in topographical work). This practically reduces us to a choice between Clarke's 1866 figure used in the United States and Canada, and Clarke's 1880 figure used by the French Service géographique de l'Armée in all their recent work, and by Gill for the 30th meridian arc in Africa. To adopt either of these in preference to a brand-

new figure such as Hayford's, or that deduced by Captain McCaw this afternoon, would save a great deal of work, since a substantial fraction of the whole geodetic work of the world would be already expressed in terms of it. In favour of the first is that the flattening is closer to the probably true value; of the second, that the major axis is likely to be nearer the truth. As the two depend on nearly the same material, it is evident that the determination of the flattening is fundamentally weak, doubtless because most of the arcs are in middle latitudes. For the same reason one may argue that all the United States work cannot contribute very strongly to the determination of the flattening, and that we shall have no good direct determination of this quantity until the Ecuador and Spitsbergen arcs are ready for incorporation in the solution.

A choice between the 1866 and 1880 figures may therefore be dictated by convenience. Which will lend itself most easily to the prompt discussion of recent contributions? I think on the whole the figure of 1880, because Gill's African arc and the new French arc in Ecuador are already computed upon it. It seems to me that the line of least resistance is to propose at Madrid that Clarke's 1880 figure should be adopted as standard; and to hope that in time, by small degrees, the rest may be referred to it. I would not say recomputed, because I think that gives an exaggerated idea of what is required. It seems to me that the principal need will be a thoroughly good set of geodetic tables on a rather new plan. It may be my want of experience in geodetic calculations that makes me think we want most of all a table of meridian arcs from the equator to say each 10′ of latitude, with the effects upon these arcs of a change of 1 per cent. in the flattening. Am I wrong in thinking that if such tables were available, a graphical adjustment of old arcs on any figure could be made, and that we could deduce pretty accurately, again by graphical methods, the contribution which any arc would make to a general solution for the figure of the Earth?

The PRESIDENT: I am sorry that owing to ill-health Sir Sidney Burrard is unable to be present, but I understand he has communicated his views to Sir Gerald Lenox-Conyngham, and I would ask him therefore to communicate them to the meeting, adding any views of his own which he desires to put forward.

Sir GERALD LENOX-CONYNGHAM: I should explain that Sir Sidney Burrard had seen a proof of Captain McCaw's paper and also of Mr. Hinks' remarks before he wrote this note, so that it falls into this part of the discussion. He would have heard what we have heard this afternoon. He writes:

"Mr. Hinks asks the question: Is the time opportune for adopting a standard figure of the Earth? In my opinion it is not opportune. We are not now in the free position of the French savants quoted by Mr. Hinks. These savants were initiating a new system, whereas we are invited to abandon an old system to which we are deeply committed. The adoption of a standard figure would necessitate the recomputation of immense areas of triangulation. In Western Europe geodesy is at present dormant under the shadow of political and financial troubles. India is passing through a difficult period; Russia is powerless to complete its geodetic undertakings. Surely this is not the time to invite these countries to re-calculate their triangulations *de novo*.

"A fundamental change such as that now proposed would take ten years in India to carry through, and its disturbing effects upon maps and publications would be felt for twenty years. Before such a big change can be recommended, we ought to be in possession of geodetic data from Australia, Africa, South America, and Northern Asia.

"Moreover, before any survey adopts a standard figure of the Earth, it ought to take two preliminary steps. Firstly, it ought to consider the effects that the adoption of isostasy will have upon its geodetic arcs. Secondly, it ought to furnish conclusive evidence as to the correctness of its initial values of latitude, longitude, and azimuth. In the case of India it would be sheer waste of time to change from the old spheroid to a new standard, unless the initial elements were simultaneously corrected. In the problem of initial elements India is ahead of most other surveys, as it has worked out the isostatic correction at its origin. But the direction of gravity is known to be abnormally disturbed at the Indian station of origin. And although innumerable observations have been taken to investigate the question, it is even now extremely difficult to decide whether this fundamental disturbance is due to local or to continental causes.

"Instead of introducing a standard figure of the Earth I would suggest that all surveys be requested to publish their gravity results, both pendulum and plumb-line, not only in terms of their own particular spheroid but also in terms of an international spheroid. For many years past different writers have shown their gravity results, derived from alternative spheroids, and Dr. de Graaff Hunter has indicated how this can easily be done. The choice of an international spheroid for gravity results would at present lie between Helmert's and Hayford's figures. Clarke's figures of 1866 and 1880 are out of date in many ways. Their values of the compression are not in accord with modern geodetic results. Helmert's figure agrees closely with Hayford's."

That concludes Sir Sidney Burrard's note. Speaking for myself, I should like, first of all, to say with regard to it, that when Sir Sidney Burrard supposes that the adoption of a standard figure means that all countries should forthwith set about recomputing their triangulation, I do not think he is taking quite a correct view of the situation. What was desired, I think, by the International Union at Rome was to decide upon what should be the international standard figure, so that new work now in progress should be based on that figure and older work be converted into those terms as opportunity and means become available. I do not think that the adoption of the figure now would involve taking up elaborate recalculations in those countries where triangulation has already been carried out and reduced.

After hearing Captain McCaw and Mr. Hinks it seems clear that no figure which has been used to any considerable extent agrees sufficiently well with the best value now available to be accepted in its entirety. If we decide on adopting one of the older figures as the international standard it must be because it will save a certain amount of work, namely the recomputation of the surveys which have been reduced to that spheroid, and the construction of tables to suit it.

Supposing that we decide to do that, it is clear from what has been said by Mr. Hinks that the two possible figures are Clarke's of 1866 and 1880. No other figure can compete with either of those. Of those the reciprocal of the flattening in Clarke's 1866 is 294·8 and in 1880 293·47. Accepting, as I think we safely may, that 296 is about the correct figure, we see that the 1866 flattening is better than that of 1880. What we are aiming at is to get a spheroid which will be useful as a figure of reference, and I think it is clear that for that purpose to have the flattening correct is more important than to have the semi-axis major correct. If we have the flattening right the shape will be right, and this is of more consequence in a figure of reference than the correctness of one dimension. That would be a slight argument in favour of

the 1866 figure as against that of 1880, though in neither is the flattening very good. The 1866 figure has been adopted for the whole of North America, and there exist very excellent tables for that figure. I incline, therefore, if we choose an extant figure, to take that of 1866.

But if we decide to ignore the fact that to adopt an old figure will save a good deal of labour, and adopt a new figure, then what shall our choice be? I do not think that any determination, not even either Hayford's or Helmert's, is so good that we should be justified in adopting it down to the last decimal. I agree with Captain McCaw that if a new figure is adopted it should be expressed in round numbers, and I think those that Captain McCaw mentioned are certainly very satisfactory numbers to adopt.

Captain McCaw in his value for the semi-axis major showed a probable error of fifty metres, and the probable error of the reciprocal of flattening was about 1·5. Mr. Hayford in his determination finds a probable error for his semi-axis major of only eighteen metres and a probable error of the reciprocal of the flattening of only 0·5, which would make it appear that his figure was a much better and more precise value than that given us by Captain McCaw. I think it will not be out of place, therefore, just to point out that there is a considerable difference between the figure that Mr. Hayford finds and that deduced by the older geodesists. The geoid, as Captain McCaw has explained, is the mean surface of the sea extended in imagination under the continents. This geoidal surface is irregular because owing to topographical and geological inequalities it is distorted from the mathematical form with which it would otherwise coincide. Suppose a section of part of the Earth and a portion of the sea, you would have the mean surface of the sea as part of the geoid, but where there is a continent and a mountainous mass the geoid will be distorted and pulled up a little. The problem the older geodesists set before them was to find the mathematical form which would agree most closely with the irregular geoidal surface. But Mr. Hayford approaches it in a different way. Accepting the theory of isostatic compensation, in the definite form into which his investigations had thrown it, he computed the amounts of the geoidal irregularities caused by the topographical inequalities and in imagination removed them, leaving a smoothed and almost regular surface. Then he found a mathematical form which would coincide as nearly as possible with that smoothed surface. It is obvious that a better fit is obtainable in this case than in the case of what I may call the natural geoid, and hence the smallness of the probable errors. The smoothed surface is not the same as the geoid; it does not, indeed, except accidentally, coincide with it anywhere, and it is not discoverable by any process of observation. The geoid has what one may call an objective existence. Any point on the coast at mean sea-level is a point on the geoid, or the surface of the water of an inland lake, if at mean sea-level, is part of the geoid. But Mr. Hayford's smoothed surface has no such physical existence; it is a deduction from a certain theory, namely, the theory of isostasy, and if we were to change our minds with regard to the theory, the form of the surface would change in consequence. I do not wish to say that I am opposed to Mr. Hayford's method. I think his method is a good one. It is a good way of finding a satisfactory spheroid of reference, but I think it is worth while drawing attention to the fact that his result is not the same thing as that which was aimed at and obtained by the older geodesists.

It is clear from the smallness of Mr. Hayford's probable errors that the fit between his ellipsoid and the smoothed geoidal surface is good, and if the

extent of the United States in latitude—Mr. Hayford's figure is based on the U.S.A. only—were greater, I should feel much inclined to accept his figures if it is decided to adopt a new figure as the standard figure of reference. But the flattening determined from so restricted a belt of latitude as the United States afford cannot be very strong, and I would be in favour, therefore, of either accepting a whole number, such as Captain McCaw mentioned, namely, 296 or 297, or else of waiting until the results of the Peru and Spitsbergen arcs are known. But I do feel, in spite of what Sir Sidney Burrard said, that to wait is not a good thing. I think we ought to come to a conclusion and to try and ensure that all work now going on is reduced to one standard spheroid, and that in the course of time all existing work may be reduced wholly, or as far as may be necessary to make their results comparable, to that spheroid.

Sir CHARLES CLOSE: I have had the advantage of seeing Captain McCaw's paper and Mr. Hinks' remarks prior to this meeting and have made a few notes. Captain McCaw has given us an excellent account of the present state of our knowledge of the figure of the Earth. We may take it that we know the semi-axis major to within about 50 metres, and the reciprocal of the compression to within a unit or a unit and a half; in fact this chapter of geodesy is nearly, though not quite, closed.

It is quite right that this Society should consider the matter, for its practical bearing is almost entirely cartographical. Thus, the Section of Geodesy of the International Union of Geodesy and Geophysics has on its agenda paper—though I am not quite sure that I have seen the latest—for Madrid, a proposal "to recommend for cartographic calculations a spheroid of reference common to all countries on one continent." It is worth while noting the expression "on one continent." As is well known, for North America the matter has already been decided.

Mr. H. Tittman, then Superintendent of the United States Coast and Geodetic Survey, writing to me about eleven years ago, with reference, I think, to Colonel Clarke's death, said: "The dimensions of Colonel Clarke's spheroid of 1866 have been found to be sufficiently close to the truth to justify us in continuing to use that spheroid for geographical purposes, and it is expected that, so far as geographical purposes alone are concerned, we shall never use any other spheroid of reference for our maps and surveys."

So far as continental areas are concerned, we are chiefly interested in Asia and Africa, for it would not affect the maps of this country if a figure were adopted for Europe by the continental nations. No doubt the Survey of India will have something to say about Asia. As to Africa, the French and ourselves are responsible for the government of larger areas than other countries, and perhaps it would be possible to come to an understanding on the matter. We have used Clarke's 1858 figure for the mapping of British tropical Africa for many years. In this figure a is only 44 metres longer tha in Clarke's 1880 figure, and the reciprocal of the compression is 0·8 larger. These small differences do not affect topography, and if Mr. Hinks' suggestion to use the 1880 figure were adopted we could still go on using the tables based on the 1858 figure, which is nearer the modern values. But when surveys are joined up there is always the question of the origin to be considered, and this is just as important as the figure. This matter is largely one of cartographical convenience, so that geodesists are not very much concerned.

There are, as a fact, two problems before us. The first is: In any given continent what measure of agreement can be attained between the different

nations concerned, as regards figure and origin, for cartographic convenience? There might be some convenience in the case of African maps if we could come to an agreement, for the mapping of Africa is still in a very primitive state, and no country is too much committed to any one figure.

The second problem is: What in the present state of the data, as a matter of scientific interest, is the best general figure? With regard to the latter problem I do not think we ought to reconcile ourselves to putting on the scrap heap all that great mass of geodetic work which is available, but which has hitherto been unused. The International Geodetic and Geophysical Union can most appropriately take charge of this problem and organize a scheme for working out a figure from all completed geodetic work all over the world. Once this was done we could all agree to give up the pursuit of a mean figure.

With regard to the practical problem, this is not chiefly the affair of geodesists but of surveyors and cartographers, and I hope that the latter will not allow themselves to be stampeded by the former.

Col. H. G. LYONS: It has already been mentioned that there are two sides to this question: firstly, what is the most precise spheroid, the one that will most closely represent the form of the geoid; and secondly, what spheroid will be the most convenient to use at the present time. It was the second question that came up at the Conference of the International Union of Geodesy and Geophysics at Rome in 1922, and I imagine that the same one will be in the foreground at Madrid in October next. The question was raised in the first instance by the Swiss delegates, who laid stress on the desirability of an international agreement as to the most convenient spheroid for use, and went so far as to say that they did not mind which one was selected as long as one was agreed upon. The question was also raised by the delegate from Sweden, no doubt in reference to the Spitsbergen arc that has been mentioned this afternoon. The matter was for the time being left in the hands of the Executive Committee, but I do not think that they have come to any conclusion yet. Therefore I suppose the question will come up at Madrid very much in the same form in which it was left at Rome; that is to say, that for the time being the question of the immediate convenience will be more in the foreground than the most precise dimensions of the spheroid, and therefore a delay in order to utilize all possible matter, as Sir Sidney Burrard suggests, is not likely to find favour with the majority of the delegates from different countries.

If my recollection is right, there certainly was a certain amount of preference expressed for Clarke's spheroid of 1880 at Rome, but it went no further than that. One of the French delegates mentioned that they are feeling the practical need for a determination of this question, so that there will be, I think, a general desire on the part of the delegates of all countries to come to a decision at Madrid. Of course in all these international conferences, unless a decision is unanimous, it amounts to nothing at all. The Union itself has no executive powers, nor do the delegates from the different countries go to the conference with any undertaking on the part of their Governments that the results to which they subscribe will be put into force; so that unless a resolution is unanimous and is generally agreed to there is not very much likelihood of much coming of it ultimately. For my own part, I am inclined to agree with Sir Gerald Lenox-Conyngham that it is desirable that a decision should be made, and my personal choice would be for Clarke's spheroid of 1880 if that can be arranged, but it may possibly be easier in the end to agree upon such a one as that described by Captain McCaw.

Col. E. M. JACK : I have nothing to say except that I agree generally with what Sir Gerald Lenox-Conyngham said. On general grounds I should be in favour of the selection of the figure as recommended by Captain McCaw rather than the adoption of some existing figure. It would probably be a closer approximation to the truth, and if we adopt a standard figure we should get as near the truth as we can.

Col. H. WINTERBOTHAM : It is quite news to me that one of the points to be considered this afternoon is that of the best figure of the Earth for cartographic convenience. I do not think Captain McCaw was aware of that fact, and I do not think it was mentioned in Mr. Hinks' paper. But if we are to consider it we should, I think, do so as an essentially different question from the choice of that figure whose dimensions are the most suitable as a medium for scientific comparison. It would be very difficult to introduce a new figure for general cartographic purposes, nor does it seem to me a matter of importance ; but if we do it would certainly be easier to choose one of the old figures than a new one. Accuracy here is not of much moment.

If we think, however, of the question of the figure best suited as a scientific medium of comparison, we ought surely to select the best we can at the present moment. Mr. Hinks spoke of those Frenchmen who introduced the metre as "having done the best that they could at the time." Surely if we are to choose a figure for scientific purposes we ought to follow the same course and choose a figure which fully expresses our existing knowledge.

The question of expediency comes in here. At the Madrid meeting, no doubt Clarke's 1880 figure might have a comparatively good reception. It is employed, in fact, by several nations who will be represented, although, of course, the Bessel, Airy, Everest, and Helmert figures will also be represented. Nations who do not use the Clarke 1880 will however not welcome a choice which will give their rivals an undue advantage and which they may fairly claim not to represent the sum total of our present knowledge.

The question has also been raised as to whether it is opportune at this time to talk about the choice of a universal figure. That point wants a great deal of thought. We have a good deal of arc measurement which remains to be incorporated, and we have an international body which may be presumed to have the power to set to work on such a problem. We have secured the co-operation of a certain number of nations, but are still looking for the co-operation of others. It would seem a little inopportune I think, with all due deference to the opinions of those who have spoken before, to hasten on the choice of a figure when we have the material for checking or improving on our present ideas.

Mr. H. L. P. JOLLY: We have already during the afternoon had it emphasized that an academic discussion as to what is the best figure of the Earth is not really influenced by any decision that we or the Madrid meeting may come to. That discussion will, of course, always go on, and I think it very likely that we never shall know the figure of the Earth very much better than we do now. I do not think that the limits which Captain McCaw has laid down will be improved upon, and for this reason : although you may add some more to those lists of arcs which have been given us, when you take mathematical means of those things you are not doing the same thing as when you apply those methods to more usual work ; that is to say, they are not really determinations of the same thing. It may be that determinations of the Earth's figure from measurements in the United States and in India never would agree however accurately they were done.

Then as to whether the direct or indirect method of determining the figure gives more reliable results. I believe I am right in saying that Helmert himself had the idea that although you could get the dimensions of the Earth better by—in fact only by—the direct method, the compression was best determined by means of gravity. Whether he would be of that opinion now that we have some more arcs in low and high latitudes, I do not know.

As regards the point which is really at issue: which figure is the most convenient to adopt immediately and whether it should be done immediately, I think the answer is undoubtedly that something should be done as early as it can be. As we know approximately the limits of the best determination that we shall ever be able to get, probably it would be desirable to have a new standard lying within those limits.

I should like to ask Mr. Hinks if he knows how much work would be involved in drawing up new tables. There is evidence that people think on those lines, because the Helsingfors Geodetic Institute has already computed some tables for the Hayford spheroid, and it seems unlikely that the work necessary, if distributed among nations adhering to the International Union of Geodesy and Geophysics, will be very laborious. One cannot have any very strong opinions on the subject as to which spheroid should be taken as standard. It rests upon whether everybody will adopt it and whether any one can be discovered who will be willing to do the necessary work in computing new tables.

Captain MOORSOM: I think nearly everything that I might have said has already been better said, but I would point out one thing, though I think either Captain McCaw or Mr. Hinks has mentioned it, namely, that there is a good deal of triangulation in the world which is quite good enough for the determination of geodetic position. That is to say, that the uncertainty in the linear position of a point is much less than the discrepancy between astronomical determination and geodetic. Although every one who does this work wants to do it with the highest possible accuracy, as a matter of fact practically the same results would be got with a triangulation of a good deal less accuracy. The plumbline deflections, in azimuth as well as latitude, are much greater than any errors that occur in the triangulation. In order to make the computation of geodetic positions more general, tables are much wanted. The United States Coast and Geodetic Survey have most exhaustive tables from the Equator to 72° of latitude in which the logs of six variables are tabulated for every minute of arc. Personally, I do not care for their formulæ, neither do I consider they are the best. I think there are some simpler and certainly more precise. But when I have done any geodetic computation, as I did in China, without any special spheroid, I have found it an enormous convenience to have and use their tables. That seems, therefore, rather a point, purely of expediency, in favour of Clarke's 1866 figure, as all the work of the United States Coast and Geodetic Survey is done to that spheroid, and, as Colonel Sir Charles Close told us, it is highly improbable they will change.

On the other hand, if the logarithmic method of computation is adopted, you get rid of the need of two of these variables and reduce them to four only, all of which have been tabulated in nearly all the geodetic surveys already. The logarithmic method of computation is certainly more accurate and simpler, although it seems to have been little used. My own prejudice is all in favour of the 1880 figure because it was used in South Africa, but it seems that the tables of the United States 1866 spheroid are an important factor. It is not

for me to express an opinion on the subject, but it seems to me that the figure of the Earth really disagrees so remarkably and frequently with any spheroid that may be adopted that it is almost entirely a question of expediency which we do adopt.

Mr. HINKS: In reply to Mr. Jolly, I am afraid I am not prepared to say at the moment what would be the work involved in computing the tables which I ventured to suggest and which I think are not existing on any figure with sufficient accuracy, that is a table of the length of the meridional arcs from the equator up to the different points of latitude. Tables frequently give the value of 1′ of arc in feet, and so on, but the integration has not been tabulated with sufficient accuracy. Captain Moorsom could probably say better than I that it would not be an enormous job to compute those tables. I think he some years ago submitted some formulæ to me at Cambridge which were designed for that very purpose.

Captain MOORSOM: As a matter of fact, in the Geodetic Survey of South Africa they have tabulated what is called the distance, the distance in feet along the meridian, of each 5′ of latitude from the 25th parallel as origin. These tables extend from latitude 21° to latitude 33°. If each of these tabulated distances is added to the distance from the equator of the 21st parallel, you name, of course, the distance from the equator of each 5′ of latitude from 21° to 33°.

Mr. HINKS: But there are no recent general tables of that kind?

Captain MOORSOM: They are the only ones I know, and they do not extend beyond 20°.

Mr. HINKS: Was the computation of them a very big business?

Captain MOORSOM: To compute the meridian distance to any given parallel is a very simple formula, but there might be more trouble in computing the effect upon that owing to change of ellipticity. Personally, I hate the ellipticity and like the eccentricity.

Captain MCCAW: An estimate of the time required for the computation of standard tables may be gleaned from the following facts. The tabled quantities were: distances from the equator to 1 millimetre and the logarithms of the two radii of curvature to ten places, all for every ten minutes from 75° to 80° of latitude inclusive. The time consumed was 4½ days, but I had previously computed a few of the constants of the spheroid (Clarke's 1880 figure).

The PRESIDENT: The discussion this afternoon, I am sure, has been one of great value. The question of the actual figure of the Earth has always proved a stumblingblock to humanity. I recall the case of a very high Lama of Tibet who assured Sir Francis Younghusband, with a faith which no argument was capable of shaking, that the figure of the Earth was that of a shoulder of mutton. Even to-day I have received two letters expressing great interest in the discussion to take place this afternoon, one of them suggesting that the meeting should look at the figure of the Earth as being an outstretched circular plane, and the other asserting with complete conviction that the Earth is flat. I do not know if I am unduly optimistic in hoping that as a result of the discussion this afternoon persons, of whom the High Lama to whom I have referred and the correspondents whose letters I have quoted are typical, will know something more than they do at the present time as to the actual figure of the Earth, in spite of Mr. Jolly's assertion that never shall we know the figure of the Earth much better than we do now. But apart from cases such as those of the High Lama and of my correspondents, I am sure that all those who move in what may be described as geodetic circles will value very

highly the paper which has been given to us this afternoon by Captain McCaw, and the discussion which has followed it. I feel sure, too, that those who have been charged by the last meeting of the International Union of Geodesy and Geophysics with the task of making a recommendation on the subject, will turn with great interest to the report of this discussion which will appear in due course in the pages of our *Journal*. I venture to offer to Captain McCaw, on behalf of this meeting, and also to those who have followed him, our most sincere gratitude for the time and trouble which they have taken in placing this matter before us.

AN INSCRIBED ROCK AT SIERRA LEONE

SIERRA LEONE, on account of its safe harbour and its supply of fresh water, was much used by vessels sailing to the East by the Cape of Good Hope. Drake touched there in 1580, on his way home from his voyage round the world. Before that date, Sir John Hawkins had made three voyages to the Guinea coast between 1562 and 1568. Then in 1568, Thomas Candish (or Cavendish) on his voyage of circumnavigation, spent several days off Sierra Leone.

William Finch, a merchant, who touched at Sierra Leone in 1607, records in his Journal that several names were found cut on the rocks—"On the further side of the fourth cove is the watering place, of excellent water continually running: at which place on the rockes, we found the names of divers English men which had bin there; amongst the rest, of Sir Francis Drake, which had bin there seven and twentie yeeres before, Thomas Candish, Captaine Lister, with others" (Purchas: MacLehose edition, iv. 1). Neither these rocks nor the cutting of the names are mentioned in the account of Candish's voyage written by Francis Pretty and printed by Hakluyt, though a rock in the "harborough," evidently conspicuous enough to serve as a mark in sailing directions, is spoken of. It was passed, however, a league before the watering-place was reached. A rock bearing the record of the visits of Drake and Cavendish would be a historical monument of great interest, and efforts have recently been made for its recovery. One of the last travellers to have noticed its existence was Sir Richard Burton. In his 'Wanderings in West Africa,' 1863, he wrote: "I proceeded to inspect the only antiquity which Sierra Leone knows. It is an outscrap of primitive rock below King Jimmy's Bridge and alongside the waterworks. According to some Sir Francis Drake . . . here left his name with the date of his first visit, others have correctly attributed it to Sir John Hawkins, the great slaver. . . . The tramping of negro feet and the waters of the rivulets have totally effaced the inscription which was they say legible 20 years ago. The rock is covered with griffonages and some well-cut letters extending to the ground: it is easy to read

M. A. RVITER
VICE-AMIRALL
VAN-HOLLANT.

"Near this work is King James' Well, a spring of great purity, which supplies the shipping."

This statement of Burton's is not at all clear. He gives no reasons for assuming, against popular belief, that it was Hawkins', and not Drake's, name that was carved on the rock.

Last year, during the course of some engineering work, a rock with inscriptions was dug up at King Jimmy Wharf, Freetown. For the details upon which the following account has been based, for the photographs, and for full-sized drawings of the inscriptions, we are indebted to Mr. B. W. Fitch-Jones, Executive Engineer of the Public Works Department. The upper surface of the stone when found was at a depth of about 6 feet below the present ground-level. From the appearance of the stone it is probable that it once stood within high-water mark. The boulder is syenite, and measures approximately 20 feet by 16 feet. When completely excavated, its surface was seen to be covered with numerous Dutch and English names, initials, and dates. Of these the most conspicuous is the following:

M. A. RVITER
VICE-ADMIRALEN
VAN HOLLANT
EN. WESTVPIES
LANT. AD. 1664

Though Burton does not give the same rendering of "Admiralen," this stone is without doubt that seen by him, on which, according to tradition, Sir Francis Drake's name had been carved. None of the inscriptions now legible on the stone appear to support this identification. The following is a list, as accurately rendered as possible, of complete names appearing upon it:

(1) Associated with the "Ruiter" inscription.
I. G. MEPPEL. O. SCIVSCK
(2) WILLIAM . STORY. 16EA74
(3) [- -] 60 MEER CLAS. MOORE
MARTIN NOVEMER . X
R . E
(4) I. ANDRIESEN I. I. HAEN 1664
AD. 1664
(5) W. V. RUPERT TAMCH
(6) ANDRENS . PEWE . 1730
(7) 1723 ISSCHR
F. SCOPLET

There are also several sets of initials and dates. The earliest date now visible is 1664, unless that occurring in (2) above is to be read as 1614, and not as 1674.

The visit of De Ruyter, from which the main inscription dates, took place during the Anglo-Dutch war of 1664–7, when an English factory on Tasso Island, in the estuary above Freetown, was burnt by the Dutch

THE INSCRIBED STONE AT SIERRA LEONE

THE RUYTER INSCRIPTION (ENLARGED)

fleet. Mr. Fitch-Jones points out that to cut such an inscription in syenite, with letters 3 inches high, would entail a considerable amount of labour. It may possibly have been done to support Dutch claims to this part of the West Coast at the conclusion of the war. Up to the present no marks have been discovered on the rock which would justify the assumption that this was the rock on which Drake's and Cavendish's names were cut, though it is possible that the letters may have been obliterated in the way described by Burton. We understand that measures are being taken to preserve the rock as a historic monument, and that Mr. Fitch-Jones hopes to continue his search for the rock bearing Sir Francis Drake's name.

THE KOGIN KOGOM KLOOF

C. Collingwood, A.M.I.C.E.

Map follows page 192.

THE Nigerian Eastern Railway seeks to serve the eastern provinces of both Northern and Southern Nigeria, tapping the coal-mines of Udi—discovered in 1909—crossing the Benue river, and reaching up to the tin-mines of Nassarawa Province around Daroro (Jemaa) and to those around Jos and Bukuru on the Bauchi Plateau. The line from Port Harcourt to Enugu is open, and the portion Enugu to the Benue and beyond is under construction; the balance was surveyed and located in the years 1921–22. One party worked from the Bauchi Plateau down the escarpment to the level of the plain of Jagindi, meeting at Ndu another party that worked up from the Benue river. The combined forces located the "link" with the original Nigerian Railway at Kaduna.

The Bauchi Plateau near Bukuru is about 4000 feet above sea, while the village of Ndu is about 1800 feet, so that the railway location had to provide for a descent of over 2000 feet in the 58 miles between Bukuru and Ndu.

Bukuru, the terminus of the light railway connecting some of the Bauchi mine-fields with Zaria, was the northern limit of our surveys. Taking a general south-westerly direction we travelled over high rocky country from which gullies led away down towards the nullahs and rivers in all directions—this is the highest part of Bauchi. On arriving near Hoss or "Makeri" we were on the divide between the valleys of the Kaduna river flowing north-west and that of the Kogin Sanga flowing south and west to join the Kogin Kogom. On the plains to the north are Fulani herdsmen, with large flocks of sheep and goats and great herds of handsome humped cattle—mostly black and white—with fine widespreading horns, who find their way in the dry summer months down into such wide green valleys as that of Kagoro.

The Ganawari hills near Hoss are the stronghold of the cannibal

THE RUYTER INSCRIPTION (ENLARGED)

pagan tribe of the same name, who still wear no clothes at all. The Attaka hills to the south are the home of another pagan tribe who also would be cannibals if and when opportunity offered! The women usually wear a sort of iron "chain-armour" dress, short and narrow.

There was much work to be done in finding the best way over the "saddle" near Hoss; and down through the Attaka country towards Moroa the location was through some rather rough and broken country. But from Moroa one passes into the beautiful Kagoro Valley proper, bridged across about halfway down by the Kaura hills. The Moroa pagans, and those at Kaura and at Madakia, belonging to the Kaje family, have all given up cannibal feasts; but with the pagans of Attaka as far down as the Kaura hills it is still the custom to drink the health of bride and bridegroom from the hollow of a freshly procured human skull.

The Kagoro are inclined to be small in stature, and as a tribe are much debased by excessive drinking. The population of the Kagoro is given as 8500, and the tribal area as 110 square miles. They are still inclined to be cannibal. In the valley around Kagoro and Kafanchan is some extremely good land that will produce at least two crops a year. The Kagoro women wear the tail of toad-stool shape.

A reconnaissance having been previously made down the valley of the Mada river by Mr. Selander, we decided to follow that route southwards towards the Benue, for close investigation showed that the route from Kagoro *viâ* the Kogin Kogom Kloof was the only one permitting a 1 per cent. grade. Let us start from a point on the Kogom river opposite Madakia and near the trail coming from Daroro, the Government station of the Jemma division, where the river flows evenly and serenely through wild meadow-land between low banks of loam and clay, and then through small park-like bush, until the river plunges headlong over a straight solid wall of rock in a fall of 70 feet. This is the highest waterfall on the Kogom; one is well able to walk underneath it, as at Niagara, and so cross to the other side.

As one approaches the Kogin Kogom from Kafanchan the ground gradually slopes more rapidly and is split up by creeks and nullahs—dry for the most part except in the rains—and divided by steep ridges. The country is covered with bush, which grows denser and taller as one descends into the hollows. In these conditions it is often impossible to anticipate with accuracy how any contemplated survey line will eventually come out. The main valley becomes so narrow below the village of Bakin Kogi that it has been named the Kogin Kogom Kloof, and the river makes a very sharp bend to the south and falls in a series of rapids and ripples at more than 1 in 80. After a bend to the west and a further bend to the south we come to the junction of the Maidaikin Kogi, and just below it that of the Takoora with the Kogin Kogom. The source of the Maidaikin Kogi is to the north-west of

Kafanchan, and it drains an area of over 20 square miles. Below the junction is a series of waterfalls—of which I have but imperfect pictures—and at a distance of about 2 miles there is another tributary to the Kogan called the Wawan Raffi (or mad stream), which drains about 15 square miles.

In the dry season—from October to March—the natives burn off as much grass and under-brush as possible, but when the rain comes again the grass springs up with astonishing rapidity to a height of anything up to 12 feet. One kind of grass has blades with serrated edges and keen as knives, which inflict sore wounds on bare arms or legs; many grasses are poisonous, and nearly all during the rains are liable to cause septic wounds.

Southward from the mouth of the Wawan Raffi there are many deep and narrow rocky gullies with dense bush on their banks, and with slopes like the roof of a house. Three miles further down on the left bank one finds the next perennial stream, the Raffid Tabba, the largest tributary stream running into the Kloof. Half a mile up from its junction with the Kogom is a useful waterfall, the bedrock being of a very dark, almost slaty appearance and extremely hard. The Raffin Tabba rises not far from Dangoma and drains an area of 20 square miles.

About three-quarters of a mile farther down and on the same side is the mouth of the Kogin Gerrti, which drains about 9 square miles and is divided from the Raffin Tabba by a high ridge on which—some 2 miles east from the Kogom river—is the village of Kanninko Gerrti. Directly west of this village and on the highest point of the ridge, I had a survey camp constructed—a site fit for a sanatorium—from which one could trace the course of the Kloof clearly in the early morning by a mass of vapour, that would contract and draw together under the sun's warming rays until it assumed the appearance of a river of rolling white cloud, seen through the tree-tops, flowing down towards Delli and the plain of Jagindi, whence the two round-topped Douchin Kogom hills could be clearly seen standing out as black rocky islets in a pale blue sea of mist.

On the south side of the Kogin Gerrti is a high rocky bluff, and the Kogin Kogom runs around its base in a series of ripples and low waterfalls until the grade flattens out, and finally the river flows down to Delli an imposing, though now less rapid and more muddy river. At Faddan Delli the Kloof ends and the Kogom valley opens out into the Jagindi plain.

The Kogin Kogom makes a huge sweep round to the west in a big bend encircling the plain of Jagindi, with the town of that name in the centre. Jagindi lies at the junction of the trade routes from the south—that is, from Keffi and Kwakwasa and Loko—and those going north to Zaria and Bauchi, and has a considerable Hausa market with both pagan and Hausa quarters in the town. The town of Faddan Kagoma is on the trade route from Jagindi to Zaria among the hills that rise from the

right bank of the Kogin Kogom Kloof. The Kagoma occupy an area of 166 square miles in the Jemaa Emirate with a population of 400 to 500. They are supposed to have migrated from the north-west of Zaria together with the Kagoro, Attaka, Jaba, Kaje, Kaura, and Moroa, to whom they show a certain affinity of language, customs, and dress, though they speak a dialect of their own. Like the Kagoro they are excellent agriculturists.

In the pagan villages of Kanninko in the mountains on the left bank of the Kogin Kogom above Daroro, the people are extremely primitive: we met many who had not before seen a white man and who were not a little alarmed at the pale face, though we considered ourselves tanned to quite a respectable hue by the time we reached Bakin Kogi at the head of the Kloof. In this locality I saw men of finer physique than any that I met elsewhere in Nigeria. Dr. J. D. Falconer says, "Jagindi and Jemaan Daroro were originally founded by slaves from Zaria, whose business was to hunt the pagan cannibals of the hills and carry them northward to the great slave markets of Hausaland. Little wonder that the land behind Daroro was long the home of mystery and that strange tales were spread abroad of the weird peoples of the hills, where the women had tails, and the men were red and clad only in caps of woven grass. The traveller must not leave the path nor seek nor hope to find hospitality within the pagan towns."

The compounds in their villages are separated by thick and often very lofty, over 12-foot, hedges of green and prickly cactus. Generally at the upper end stands a cluster of grannaries. The huts are of mud and round, with conical roof. The Kanninko pagans are excellent bush men and hunters, but not so expert at fishing or at the manufacture of boats or canoes; nowadays they are becoming more and more agricultural. The men and boys wear triangular-shaped loin coverings, and often a skin slung from one shoulder; the women wear a string of woven hair and maybe a loin cloth or a bunch of fresh leaves; girls wear a short kilt of strings of beads adorned with cowries, and generally worn to one side. Very few understand Hausa at all. Their arms consist of bows and arrows, the latter dipped first in vegetable poison, allowed to dry, and then smeared with a fœtid animal virus.

In the towns of the Jemaa Emirate Muhammedanism is spreading rapidly, but "as much for social as for religious reasons."

The country surrounding Jagindi is extremely rich and fertile, and could maintain a much larger population than at present.

It was important to establish the names of the five tributaries of the Kogin Kogom, in the Kloof on the left bank. The Serraki (or Headman) of Faddan Delli, with the Serraki of Jagindi, and official messengers from Jemaan Daroro, agreed that the names as given above were, and should continue to be, the recognized names of these important streams.

Some 20 miles south of Jagindi on the left bank the Kogin Kogom

joins the mighty Kogin Sanga, and thence onward the combined waters are known as the Mada. When I first encountered the Kogin Sanga I could find neither boat nor canoe, and had to swim across the river when the discharge was about 5000 cubic feet per second. Subsequently the best that could be obtained was a fragile bamboo raft lashed upon four large calabashes for floats, upon which we transported all our instruments and valuables. The native of that part would swim across readily enough, taking a load on his head, with the support of a large hollow calabash under his "middle." The Kogin Mada continues southerly through the Mada country and the more level plain of Keffi and Lafia, and flows finally into the River Benue—under a different name.

We found several wild citrous fruits; also mahogany, rubber, and the ubiquitous fan-palm and oil-palm. Some of us found spoor of bush-cow and leopards; while monkeys, rock-rabbits, porcupines, ant-bears, and baboons abounded. Birds, even the greater and lesser bustard, Marabout stork, crown cranes, partridges, and guinea-fowl in abundance, besides parrots, parakeets, green pigeons, blue starlings, jays, and canary birds of bright and beautiful plumage. For the lower forms of life—such as flying and creeping insects—I should say the Kloof was a very happy hunting-ground. We saw at least ten different kinds of praying Mantis, and nearly every variety of Stick insect. I regret to say that the presence of the tsetse fly in and around Jemaa and along the Sanga and Mada rivers made itself felt, but am glad to report its total absence from Fadan Zagoro to Fadan Delli and from all the highlands of the Bauchi plateau.

THE MOUNT EVEREST DISPATCHES

WE print below the dispatches which cover the heroic and tragic events of the Mount Everest Expedition from its arrival in the Rongbuk Valley until its withdrawal after considerable success and heavy loss. The story will be re-told in lecture and book: yet never, we think, more effectively than in the dispatches which have compelled admiration as they were published from week to week, but must be read consecutively for full appreciation. It is Colonel Norton's singular good fortune that his style rises with his altitude, and with the height of his subject. His eighth dispatch, dictated when blind, and his last with its noble tribute to the lost companions, will surely become historic in the literature of mountaineering. Characteristically he gave it to his colleagues to narrate the three great exploits: the rescue of the four porters who had lost their nerve, told by George Mallory in the last effort of his gifted pen; the record climb in which Somervell was beaten at 28,000 feet, and was left to describe how his chief struggled a little higher; and

lastly the strange and wonderful story by Odell, in support on the last high climb, to whom, as he made a lonely geological survey between Camps V. and VI., was suddenly revealed for a brief time the last sight of Mallory and Irvine as they gained the crest below the final pyramid, and disappeared for ever into the cloud about the summit.

The dispatches are cabled in slightly abbreviated form, with little punctuation. By the courtesy of the Editor of *The Times*, to whom they came for distribution, we have been allowed to compare the first published versions with the original cablegrams, and have corrected a few evident mistakes in transmission, adding an occasional note in explanation of such change. Otherwise they stand as they were first printed.

COLONEL NORTON'S DISPATCHES

NO. 6: BASE CAMP, RONGBUK. MAY 13
[PUBLISHED MAY 31]

When I last wrote hence on April 29 things had gone so smoothly that we were wondering when the crash was coming. We had reached the Base Camp exactly according to plan and, amply provided as we were with local labour, the way seemed clear before us to a possible assault on the mountain somewhere about May 17. Portraits of the gods guarding Everest are painted on the walls of the Rongbuk Monastery. We studied them with interest and smiled.

The first task, after Camp II: had been established and stocked by local labour with all stores for the higher camps, was to transport the necessary proportion to Camp III. with our own specially enlisted porters. On May 3 Mallory, Noel, Odell, Hazard, and Irvine started for Camp III., accompanied by twenty ot these porters. On the following day Havildar Umar, 6th Gurkhas, followed with twenty more porters. These two parties were to complete the establishment of Camp III., close under the glittering wall of the North Col with all stores required for itself and the higher camps, and then to proceed with stocking Camp IV. on the North Col itself, as soon as the snow and ice staircase to that point had been reconnoitred and constructed by Odell and Hazard. A reserve of twelve porters, including some of the toughest veterans of two years ago, was maintained for the moment at the base, under Geoffrey Bruce. Somervell, Beetham and I left the Base Camp on May 6. It was a very clear, cold morning, after a night when the temperature at the Base Camp fell to *minus* 10° Fahrenheit. We arrived without incident at Camp II. on the morrow, finding Noel there. The same evening it began to be clear that all was far from well. A party of porters based on Camp II. had made two trips towards III., but encountered such low temperatures, combined with head winds, that Mallory decided to establish a dump for stores at a point on the glacier about a mile short of the camp.

But who are these weary, crippled men coming staggering and straggling through the seracs of the glacier into Camp II., between 4 and 6 p.m., from the direction of III., looking for all the world like the stragglers of the British Army I once saw blocking the roads south of Le Cateau on August 27, 1914? It appears that they are porters of the first party from Camp III. They have made one "carry" to that camp two days ago, and are now clean driven out by exposure and exhaustion after spending forty-eight hours practically confined to the tents, with only bare necessities in the shape of food and clothing—

in other words, a blanket apiece and the local barley meal to eat. The ample and varied supplies of food and spare blankets and most of the fuel are still dumped on the glacier a mile short of their camp. As at St. Quentin, Chauny, and Noyon in 1914, there is now no time to count the cost nor look far ahead. The stores dumped at II. for all the higher camps must be ruthlessly broken up and expended. The high altitude tents are pitched, the priceless stores of Meta solidified spirit are broached, high altitude sleeping-bags are issued. The capacity of Camp II. is doubled for the night and some degree of comfort is extended to the sufferers.

On the morrow Mallory arrived at breakfast from Camp III., and we held a council of war. Mallory's story was short and sweet. Temperatures as much as *minus* 22° Fahrenheit, 10° lower than anything met in 1922, coupled with terrible wind and the failure of the majority of stores from II: to reach Camp III:, explain the rout of the first party. Mallory himself ordered the retreat, and had practically to man-handle many men out of the tents on to their feet, so completely had the hardships taken the heart out of them. Such weather conditions surely must be exceptional, and it was decided to rest and recuperate the first party at Camp II., and next day to send the second party from Camp II: without loads to the Glacier dump, thence to carry all essentials up to Camp III., where they were to remain, changing places with the first party. The situation was explained to the men, and the second party went off on their third trip in four days in good heart, under Somervell's escort.

Geoffrey Bruce now arrived at Camp II. with the old guard, affording neither the first nor the last instance in history when the commander blessed his reserve. This day Odell and Hazard attempted to reconnoitre the route to North Col, but the conditions were such as precluded their reaching more than halfway, making a dump of rope pickets. The next day Mallory, Geoffrey Bruce, and I left for III. with a convoy, very much more cheerful than the first party, and a reserve carrying stores partly to the dump and partly through to Camp III. Hazard, who was sent to the base to relieve Shebbeare, met us *en route*. I have a sharp silhouette of him in mind as I write, making famous going down the glassy surface of the glacier in the teeth of the gale, with his beard and moustache iced, so that he looked like Father Christmas. Shebbeare's special qualifications as transport officer now called for his presence at Camp II., where it was hoped under more favourable conditions to dispense with an officer.

Now began a blizzard lasting continuously for forty-eight hours. Strictly speaking, it only snowed for perhaps twenty-four hours, but the conditions subsequently were identical, or worse. The wind increased after the snow ceased to fall, driving the fresh-fallen powdery snow before it in incessant gusts, producing much the same results as if snow were falling, combined with a lower temperature. All woke at Camp III. on the morning of the 10th to find the tents filled with inches of powdery snow. It was now apparent that it was inadvisable to maintain more sahibs than were necessary under such conditions at Camp III. The carriage of provisions and consideration of the condition of those climbers destined for an early attempt outweighed the acclimatization question and decided Mallory and Irvine to return to Camp II:, which they did after breakfast. Somervell and I escorted a party from Camp III: back to the dump, and returned well laden in the teeth of driving snow, while Geoffrey Bruce stimulated the reluctant camp into activity, and did what could be done under impossible conditions to evolve order out of chaos and comfort out of misery.

The night of the 10th–11th served the purpose, perhaps, of testing the

wind resistance of our apparently flimsy high altitude tents; for all other purposes it is best forgotten. The wind appeared to be shot high in the air over the North Col, Rapiu La, and Lhakpa La, the three passes surrounding us, and, from some point high in the zenith, descended on the camp like a terrier on a rat-pit, and shook our little tents like rats. The minimum temperature was *minus* 7°, and the tents were again filled with drifted snow. At 9 a.m. on the 11th the temperature was still *minus* 1°, a gale was raging, and everything was deep in snow. The North Col route would in no circumstances be safe for some days. The much-enduring second party of porters were now reduced nearly to the condition which the first party had reached three days before.

There was nothing for it but retreat—retreat to the Base Camp for a few days' recuperation before making a fresh start. Messengers were dispatched to Camp II. with instructions to evacuate it in hopes that they would reach there in time to stop any upward convoy. Then Geoffrey Bruce did a fine bit of work, though it was very much in the ordinary day's work for him. Taking up a commanding position in the centre of the camp in the teeth of the gale, he proceeded to order the striking and packing of the camp, for it was impossible to risk standing or even collapsed tents in such weather. How he got the men to work, the tents struck and packed in bags and boxes, bedding, stores, and fuel all neatly dumped, only he can tell. Perhaps his stinging words cut more than the wind, but it is on record that he found time and opportunity to give exactly the right amount of sympathy to the really sick and to those who thought they were more sick than they were. Such loads as were to accompany our downward course were fairly and justly apportioned, and to his credit, be it said, a comparatively cheerful party thankfully turned their backs on what had an hour ago been Camp III., and which was now something resembling a neat pile of stones.

Halfway down that weird corridor, with blue ice pinnacles, resembling nothing so much as a transformation scene at Drury Lane, which forms the lower road from Camp II. to Camp III., we met the convoy for Camp III., our note having arrived too late to stop it. Never mind, they can go right through to the base next day. Our convoy goes through to Camp I., with Mallory, Noel, Irvine, and Beetham in charge, and Somervell and Odell as far as Camp II. Geoffrey Bruce and I spend the night at Camp II. to look after and escort on the morrow a man who had broken a small bone in his leg on the glacier. So by 2 p.m. on the 12th the whole expedition was again at the base. And what a different base from that which we thought so bleak a fortnight ago! Bleak it still is, with no sign of the stir of the Tibetan spring in scanty vegetation and grey moraine heaps, but a garden of roses after III.

The end of Round One finds us discomfited, but very far from defeated. A hitch, but by no means the crash we feared, has come. We have one man with seriously frost-bitten feet, one with a broken leg, and two severe cases of bronchitis, and, worst of all, Lancenaik Shamsherpun, of the 6th Gurkhas, suffering apparently from hæmorrhage of the brain and in a serious condition. We lose inevitably five or six days of the original programme. On the other hand, when we reoccupy Camp III. in three or four days, we shall have no need to look over our shoulders. Everything will be up and the proportion of stores to go up higher will be a fleabite compared with what has been done. Porters and sahibs are acclimatized and tested up to 21,000 feet. We know our good carriers. Already, twenty-four hours after arrival at the Base Camp, the porters have got over most of their minor ailments and fatigues, and are showing

normal cheerful faces. We hope to get them and the expedition as a whole blessed two days hence by the Head Lama at Rongbuk Monastery, who was too sick to do this when we passed through Rongbuk.

The British members of the expedition are in perfect health, despite their roughish experience. Give us but the weather encountered in 1922 and nothing will prevent the smooth continuance of the plan, with ample time to carry it out. The brightest spot on our arrival at the base was to find that Hingston had rejoined, after leaving General Bruce at Darjeeling, in the nick of time to relieve Somervell of some of the arduous duties of medical officer.

Since writing the above I have to record with the greatest regret the death of Shamsherpun, painlessly, and without recovering consciousness. The death of this splendid young man in the prime of youth is much felt by all the members of the expedition, who, in tendering their sympathies with his relatives and the regiment, feel that they have lost a friend and a most loyal assistant.

NO. 7. CAMP I. EAST RONGBUK GLACIER. MAY 26 [PUBLISHED JUNE 16]

"No game was ever worth a rap for a rational man to play into which no accident, no mishap, could possibly find a way." This sentiment must be our consolation as I start the seventh dispatch from the Everest Expedition, for since I last wrote we have done little but provide Everest with games worth raps enduring [? message mutilated]. The task of describing our doings in detail I am leaving to the ready pen of Mallory, confining myself to a brief epitome of the events which led to our finding ourselves once more temporarily defeated and strung out in echelon between the Base Camp and Camp II. for two or three days' recuperation from the rigours of Camps III. and IV.

We advanced for the second time to the attack on May 17, the day originally planned for the first assault on the summit. As luck would have it, this was, perhaps, the most perfect day I have ever seen on the mountain, certainly the only day of the sort seen this year. We arrived on May 19 at Camp III., and on the 20th a party consisting of Mallory, Odell, and myself established a route to the site of Camp IV. and on to the North Col itself.

On the 21st twelve porters, escorted by Somervell, Hazard, and Irvine, established a camp on the old site. Incidentally, no sign could be found of the old camp established there in 1922. All was buried deep under the snows of two winters and two monsoons. Somervell and Irvine returned to Camp III., leaving Hazard in charge of the twelve porters, pitching camp in a snowstorm at 5 p.m.

On the 22nd a similar party under Odell and Geoffrey Bruce were to have repeated the trip, but as snow had started falling at 1 p.m. on the previous day and continued unintermittingly for twenty-six hours, the attempt was impossible. The night of May 22–23 produced the lowest temperature recorded by the Everest Expedition—56 degrees of frost. Many of the party at Camp III., which now included five climbers, did not sleep. The eiderdown sleeping-bag is a wonderful invention, but it has its limitations. Enboldened by the low temperature, the brilliant morning, and other reassuring indications, and urged on by the consideration that priceless days were slipping past, a party of sixteen porters, under Bruce and Odell, left on the morrow for Camp IV. Halfway up the steep snow and ice slopes the party encountered such dangerous conditions underfoot, aggravated by the fact that it began to snow hard again, that the attempt had to be abandoned, and the party returned to Camp III., dumping their loads at the highest point reached by the porters.

From there they saw Hazard descending through the snowstorm above them, escorting what it was hoped would be his whole party. At about 5 p.m. the party arrived, Hazard having rightly judged that there was nothing for it but evacuation. He had shepherded the party safely down the unpleasant descent, but most unfortunately, while he was in the post of danger ahead, going first to test the treacherous new snow, the last four men lost their nerve and turned back to Camp IV., where they remained marooned, their food supply, it turned out, confined to a sack of barley meal, as, two days before, a complete load of mixed luxuries had been accidentally dropped over an ice cliff by the porter who had been carrying it.

Here was a pleasant situation. The snow continued to fall until midnight, increasing in volume, and, what was worse, in softness. In fact, the indications were multiplying that some form of monsoon current was undoubtedly upon us. Yet the four unfortunate marooned men had to be extricated, and that without another day's delay. One man had already been reported frost-bitten, and it was impossible to say if he would be fit to descend even on the next day. The whole party in Camp III. were in none too fit condition. Five days of alternate heavy climbing and lying snowbound in 16-lb. tents and five nights with temperatures averaging 50° of frost had played havoc with the health of all, British and Himalayan, and to some extent also with the *moral* of the latter, many of whom were shaken.

The route to the North Col would obviously be unsafe for some days to come. Meanwhile our stores of food and fuel—the former replaceable from below, the latter irreplaceable—were being consumed at an alarming rate. There was nothing for it but once again to withdraw to the lower camps, where sleep and some degree of comfort could be obtained and where the usual yak dung could be burnt instead of artificial fuel. Accordingly a twofold operation was carried out on the 24th—the evacuation of Camp III. and the rescue of the marooned men from Camp IV. Of this Mallory will tell the story. That he was himself suffering from the prevalent high-altitude cough—which prevents sleep at nights and handicaps the climber—and yet was the mainspring of two fine climbs, he will probably not tell, but few would, or could, have done what he did.

Hence, to-day finds us echeloned up the East Rongbuk Glacier, ready to repeat our attempts on the mountain with but a day's delay when the weather permits. Once more the *via dolorosa*, threading the moraines of the glacier, has witnessed a melancholy little procession of sick, frostbitten, and snowblind men painfully wending their way to the comparative comfort of the Base Camp, where there are adequate medical arrangements. At Camp I. we are occupied in recasting our plans. If the monsoon is really on us—and who ever anticipated the beginning of the monsoon as early as May 19?—our only hope is largely to modify our plan and snatch fleeting chance in some fine interval. If it is only the preliminary current, to be followed even now by a real spell of the fine weather we have looked for in vain, we must be prepared to take advantage of it. But we have our warning. Prudence must recognize the third alternative, which, however, I prefer not to discuss. Here I let Mallory take up the story.

MR. MALLORY'S STORY

"This pause in our protracted struggle does not seem the moment for telling a story; Norton probably thinks so, as he hands over this part of his task to me. Action is only suspended before the more intense action of the climax. The issue will shortly be decided. The third time we walk up East Rongbuk

Glacier will be the last, for better or worse. We have counted our wounded and know, roughly, how much to strike off the strength of our little army as we plan the next act of battle.

"In making plans, however, though we turn from the story of the past to the brighter future, we have been brought to consider certain events of the past few days. The events all belong to one stage—between Camp III., 21,000 feet up, and Camp IV., 23,000 feet up, and still 6000 feet short of the summit. In 1922 the way here consisted of a brief hour's easy going up the stones of the glacier, followed by a steeper ascent of about 1400 feet on snow and ice slopes, and up and down these slopes the men went freely, without thought of the difficulties, until the party of seventeen was swept off them by an avalanche and seven porters were killed. That was on June 7, after the first big snowfall of the monsoon on June 3–5. Naturally now in 1924 we do not mean to be caught in the same way again, not if we can help it.

"It is when we think and think how we can make safe the way to Camp IV. up on the snowy shelf among the great ice-cliff of Chang La that we begin to appreciate the immense difficulties Everest holds in store. It must be remembered, in the first place, that our great ally, the Sherpa porter, is not a practised mountaineer. Give him good hard snow where nails can grip, slopes where he can just walk comfortably on good steps carved by the sahib's iceaxe clean and clear, unencumbered by fresh powdery snow; give him a rope for a handrail here and there at danger points; give him, above all, to believe that at the journey's end he will find good food and a warm bed, and he will go up and down steep tracks without a qualm, happy, confident, and safe.

"But the mountain does not always acquiesce in this cheerful view. The first weapon of defence is simply the cold. It seems cold beyond a certain point somewhere about −10° Fahrenheit at night. The cold at these altitudes and under these conditions, whether in camp or on the mountain, tends to cause the expansive Sherpa's nature to contract. It is not surprising, when the hard conditions of their life are considered, that the porters, with few exceptions, lose their vitality most quickly in great cold. Nor can it be said that the British sahib is unaffected.

"The second weapon is the snow. The fewest inches of snow enormously increase the labour of carrying a load from Camp III. to Camp IV. All that was firm and sure becomes slippery and uncertain. The porter no longer distinguishes clearly the hole where his foot may be placed in the new snow, and is inclined to slide on the hard old snow or on the ice beneath as the powdery stuff blows up into his face. Instead of stepping in glad confidence, body erect, he begins hesitatingly to crawl, with his body hugging the slope. All sense of security is gone; the splendid fellow who bore his load so proudly has become a veritable child, a child for whom the British officer is at every turn responsible.

"The fortune of this expedition in 1924 is sharply differentiated from our experiences in 1922 by the greater cold this year, and the greater snowfall to date. It is, of course, the snowfall which has chiefly affected the mountaineering difficulties between Camps III. and IV. The particular slope of the corridor where the avalanche occurred in 1922 is not dangerous every day, and was in perfectly good condition when Norton, Odell, and myself set forth to reach Chang La on the 20th. Nevertheless, warnings of bad weather already received convinced us that we must establish at the outset a way independent of this slope in case of heavy snow.

"The rules of this game, so to speak, are that you may directly ascend a slope in comparative safety, but must never cross a slope, where the snow is

likely to slip just by crossing it, and so breaking the surface, you are likely to start an avalanche. The corridor in 1922 was unsafe after the monsoon snow had fallen because the floor was on a slant, so that, though one might feel that one was going directly up a slope, one was really crossing one all the time. Now, as one looks up at the intermingled masses of white broken snow and bluish broken ice below the long snow saddle called Chang La, or North Col, it is almost unimaginable, if one does not take the corridor leading directly to the strategical point, that it will be possible to regain this line and reach this point without crossing one or other of the snow slopes, all of which are dangerous to cross after sufficient snowfall.

"Away to the right, separated from the corridor by a series of icecliffs, we saw the long slopes used for the ascent by the first 1921 expedition. The place has changed a good deal since, but the lower slopes remain substantially as they were, while higher an immense crevasse curves across the face and stretches to the upper end of the corridor. Would it be possible to use this crevasse if we came up to the right to take us back to the head of the corridor? Clearly on the lower lip, if we could work along, we should be protected from an avalanche from above. Any party making fresh tracks up to Chang La from Camp III. will find they have a full day's work, though on the 20th we had favourable conditions and went slowly enough.

"At length the steep slope brought us to the crevasse and the one real difficulty of the route. On the lower lip, which we wanted to follow, impinged hereabouts a line of ice-cliffs. It was necessary to climb up the steep wall to the foot of the little chimney which here represented our crevasse. The snow in the bed of this chimney gave no foothold; steps could not be cut in its sides, so inconveniently narrow it was. Before we emerged and found ourselves on the big crevasse proper, with the lip fortunately accessible, we had climbed 200 feet as steep and difficult as one could wish to find on any big mountain.

"The rest of the way gave no trouble, though taking the straight way in order to avoid traversing the final slope up to the old site of Camp IV. involved more step-cutting. We congratulated ourselves on having shared the labours of the day, so each could feel satisfied at his part and also at having eliminated the principal dangers on the way up. But it remained to be seen how the porters would manage the loads up that steep 200 feet.

"On the following day, the 21st, Somervell, Irvine, and Hazard set forth to escort the first lot of loads to Camp IV. It was snowing slightly when they started, and the day grew worse. Somervell found our tracks covered or could not find them at all. The ice chimney no doubt they rightly decided was too narrow for the majority of the loads. Somervell and Irvine established themselves at the top while Hazard directed operations from below, and all twelve loads were hauled up. Tremendous efforts must have been required of those two who hauled and the two or three porters who helped. Two hours and a half were thus spent. Having seen Hazard up to the foot of the final slope Somervell and Irvine returned. According to plan the porters were to rest next day at Camp IV. before going on with Bruce and Odell to establish Camp V. This operation has to be conducted with oxygen. Irvine was now wanted in camp to prepare the apparatus for the next day. In such thick weather Somervell judged that Irvine must have a companion on the descent.

"A further illustration of the mountaineering difficulties in reaching Camp IV. is the story of the party conducted by Bruce and Odell on the 23rd, a day later than they were due to go up. Fresh snow had greatly altered the easy walk up the stones of the glacier. Instead of a brief hour up to the foot

of the slopes nearly three hours were required. On the slopes themselves snow was found to be in the most disagreeable state. Hazard's party were coming down the ice chimney as Bruce and Odell, having left the porters lower down, were approaching the crevasse. They did not reach the crevasse, deeming the snow dangerous. Hazard was apparently deaf to their shoutings, and for an hour or so the two parties were never in touch.

"The two stories we heard in Camp III. that evening, with the news that not all Hazard's party had descended, mingled as we lay in our tents with the sound of ever-increasing snowfall, produced the nearest thing to gloom I remember during the expedition. As night came on the snow had a moister and stickier quality. Was this really the monsoon then? Four men caught on Chang La for the first snow of the monsoon. One of them reported frost-bitten. It was this circumstance that compelled rescue the next day and no later. I woke in the early part of the night for a coughing fit. The tent was brighter, and Norton murmured: 'The moon.' Sure enough, looking behind me, I made out through the canvas a bright unclouded moon. The snow had stopped. It was not the monsoon this time.

"Was there ever such a party as set out straggling up the snow-covered stones next morning? Norton, Somervell, and myself, the three who have climbed together on Everest before, must have appeared like a party of thrashed curs. I suppose we were half sick with the cold and the altitude. Never can three men have looked less like accomplishing a hard task; never, I confess, has a task appeared to my mind so utterly far away and unlikely to be accomplished. We drove ourselves somehow or other over the fresh snow of the glacier basin and up, up, slowly and wearily, puffing and coughing. 'If only it were not for that blessed cough,' I thought, 'even in snow up to my knees I could have gone on well enough.'

"We started at 8 a.m.; at 1.30 p.m. we were at the foot of the steep place below the ice chimney. Every ledge and step were filled with snow. But there remained the thin descending line of rope, fixed by Somervell's party to help the porters. That blessed rope! How pleased we were to grasp it with both hands and pull ourselves up the steep places! On two dangerous sections above the crevasse Norton and Somervell in turn went ahead on the long rope, while the remaining two secured them.

"While Somervell was leading up and across the final slope the four porters above were held in conversation. As there was no time to lose, we wanted to know whether all were ready to move. The question appeared to puzzle them. Eventually one asked, 'Up or down?' Norton's reply seemed to surprise no less than delight them, so little had they realized the situation or appreciated the threat of more bad weather. It was 4.30 p.m., and we were already in cold shadow when Somervell reached the shelf, or, rather, reached within a few feet of it, for the rope on which we held him was just too short for the purpose. The quickest way, we had decided, was to make a handrail and send down the men one at a time to where Norton and I were posted; but now the proposed handrail did not reach far enough, and the men had to move two or three steps before they could reach it.

"Watching with some anxiety Norton and I suddenly saw two of the four men sliding down the steep snowslope. By some miracle they stopped some 15 feet below. Somervell was entirely equal to the occasion. We heard him shout: 'What's Khaskura for: Stay still?' Norton gave the right expression, and the two, clinging in their precarious situation, with fingers dug into the snow—neither had an ice-axe—were duly instructed not to stir for their lives.

The others were passed along the rope. Somervell stuck his ice-axe into the snow and passed a rope round it, and in a few minutes we saw him apparently gather to his bosom the errant porters in a paternal manner worthy of Abraham. The two were passed along the rope.

"It had been our great good fortune to find that the frostbitten member of the party of porters had suffered not in his feet but in his hands. We had not to use our one man-carrier brought up by Norton. He could go down on his own feet. He was a very sick man nevertheless. The ice chimney was no place for one hardly able to bear holding the fixed rope, and in our race with the oncoming darkness he necessarily suffered. But it was well for him, as for us, that the race was ours.

"As I headed the party trudging a little grimly across the glacier basin in the last light of day I dimly made out a party approaching. It was Noel and Odell, with two or three porters bearing hot soup in thermos flasks. *Sic itur ad astra.* They will deserve their thrones in Heaven. But not every party descending from Chang La will find good tracks and an untroubled evening, still less will they meet hot soup. We know now what we have to do to make safe the way. We expect no mercy from Everest. Yet perhaps it will be as well he should not deign to take much notice of the little group of busy ones on the great north side, or, at all events, that he should not observe among the scattered remnants he has half put to flight the still existent will, perhaps power, to sting his very nose-tip."

NO. 8. CAMP III. EAST RONGBUK GLACIER. JUNE 8 [PUBLISHED JUNE 26]

I dictate the eighth dispatch from Camp III. I say dictate, as I am unable to write, as I am just recovering from an acute attack of snow-blindness, whereof more anon. Geoffrey Bruce, jack-of-all-trades, is my secretary. Both of us having had a go at high altitudes feel that this particular kind of work for the moment is what exactly suits us.

Above towers Everest, somewhat powdered with fresh snow, still and windless, and half shrouded in that type of damp, sticky cloud which surely this time presages the advent of the monsoon proper. Every eye in camp is turned on the final pyramid. Expectation is at its keenest, for somewhere there the final attempt, as it must inevitably be, is at this moment deciding the success or failure of the 1924 Expedition.

When last I wrote I explained that the original plan would require modification, partly owing to uncertainty, more definitely owing to the exhaustion, physical and moral, of the porters. I propose shortly to describe the psychology of these interesting men in more detail. At present it must suffice to say that Geoffrey Bruce and Shebbeare, who know them best, agreed that twelve to fifteen at the time of the return to the assault was the maximum to be depended upon to go beyond the normal 23,000 feet. It behoved us to cut our coat according to our cloth.

At a conference of climbers at Camp I. on May 27 it was decided that for the present the use of oxygen must be discarded; that a series of at least two attempts without oxygen, sleeping two nights on the mountain, above 23,000 feet, with the absolute minimum of organization should be made; afterwards as the fates might decide. Another precious day of fine weather was sacrificed on the 28th to the recuperation of the climbers; no doubt the results repaid the risk. The day, further, was utilized by those ingenious and infallible

mechanics, Odell and Irvine, in constructing a rope-ladder from Alpine rope and tent-pegs, to enable the loaded porters to negotiate safely the ice chimney leading to Camp IV., of which you have already heard. Like all the work of the well-known firm of "Odell and Irvine," this proved a most complete success.

The weather now was apparently almost perfect for our purpose. The mountain day after day was standing clear cut in azure; day after day even the streamer cloud, the hall-mark of the master peak, was lacking from the master of all. The preliminary monsoon symptoms had entirely disappeared, yet we well knew that the monsoon might at any moment be on us in full force. The parties selected for the first two assaults were Mallory and Bruce, and Somervell and myself, with Odell and Irvine supporting on the North Col.

The party reached Camp III. on the 30th, accompanied by Noel and his kinema outfit. Hazard, destined to support from Camp III., arrived a day later. Beetham, unluckily suffering from an attack of acute sciatica, determined not to be out of the hunt, had broken off from the doctor's supervision at the Base Camp, and struggled manfully to Camp III. with his usual determination, prepared to cook, climb, or carry, indeed, to support the climbers in any way possible. It was my painful duty to return him to the Base Camp with an order to release Hingston, so that a doctor should be available to ascend to here and look after possible casualties. It must not be forgotten that the 1924 expedition is two under strength.

With the above climbing parties at Camp III. were assembled that picked gang of porters who were considered still reliable to go high. They were fifteen in number, and distinguished by the name of "Tigers." At the stage set for the final attempts on the mountain the weather continued perfect. On June 1 Mallory and Bruce, accompanied by nine of the "Tigers," camped at the North Col [Chang La] establishing *en route* a rope ladder. Odell and Irvine were to remain in support at Camp IV.

On June 2, still apparently under perfect weather conditions, the two climbers and eight porters started up the great north ridge to establish Camp V. But the weather on Everest is not always what it seems. Once past the jumble of crevasses and seracs separating Camp IV. from the true col, a bitter north-west wind, one of the most formidable foes we have to face on Everest, smote the little party on the flank. This wind must be felt to be appreciated. Every member of the party was equipped with every device of windproof clothing experience could invent. Yet such is the keenness of the wind that it appeared to have the double quality of penetrating through and yet nearly blowing the laden porters out of their steps.

Progress up the north ridge of Everest does not lend itself to description. It is a fight against wind and altitude, generally on rock, sometimes on snow, at an average angle of 45°. It will appeal to those who have ever tried mountain climbing above 23,000 feet. Camp V. was to be situated on the east or sheltered side of the ridge at about 25,300 feet. At about 25,000 feet the endurance of the porters began to flag, and of eight only four made Camp V. under their own steam. The remainder deposited their loads, unable to go on. While Mallory set to work to organize the camp, Bruce and one Lobsang, meriting the distinction of being one of the leaders of the "Tigers," made two trips back from the level of the camp and brought up the missing loads on their own backs. Whites cannot carry loads at these altitudes with impunity, and it is scarcely to be wondered at that Bruce's heart was strained, happily only temporarily, in this fine performance.

Camp V. was now established—two fragile 10-lb. tentlets perched on an

almost precipitous slope. The tents occupied by the non-oxygen party in 1922, collapsed and held in position by big stones, were clearly seen 200 feet below. According to plan, five porters now returned to Camp IV., three picked ones being retained to sleep the night and carry a tinier camp some 2000 feet higher on the morrow. Obviously everything depended upon the physical condition and *moral* of these three men. The most persuasive powers of Bruce could elicit little enthusiasm from them as to their next day's task. Apparently the wind had taken the heart out of them. With no rosy anticipations the party went to bed, with the sun still gilding the tops of the surrounding mountains, after the truly miserable but inevitable routine in high altitudes of cooking the dinner.

It was intended to make an early start next morning. This has been done, therefore is not impossible, but when Tibetan porters are concerned it certainly approaches the limits of the possible. Making a long story short, a series of visits to the men's tent while the climbers' breakfast was being prepared produced in the end nothing but the most unwelcome information that only one was fit to proceed. The other two professed to be sick and totally unable to carry a load. Bruce talks their language fluently and has great influence over them, and there is not the slightest doubt that if anybody could have stimulated them to go on it was he. It was fairly evident that the three porters had shot their bolt, and that nothing more was to be got out of them. After a brief consultation it was decided to return to Camp IV. Halfway down the party under Somervell and myself, timed to follow the footsteps of the first party one day behind, was met. The doings of the second party will be separately chronicled by Somervell.

Mallory and Bruce, on arrival at the North Col, were met by Odell and Irvine, who were fulfilling, for the first time in the history of Everest climbing, the official *rôle* of supporters. Since 1922 we have recognized the necessity of this *rôle*, picturing the comfort to a returning party of weary climbers such support might afford. The most optimistic imaginations fell short of the reality, as produced by that "well-known firm." For over a week those two have lived on the North Col (23,000 feet), and have cooked every meal—and only those who have done it can appreciate the recurring hatefulness of this operation. They have gone out day and night to escort and succour returning parties of porters and climbers over the intricate approaches to the camp, carrying lamps, drinks, and even oxygen to restore the exhausted. They have run the camp and tended the sick, and Odell, for one, has been down to Camp III. and returned to Camp IV., escorting parties or fetching provisions on three consecutive days. Whether we reach the top or not, no members of the climbing party can pull more weight in the team than these two by their unostentatious, unselfish, gruelling work.

The following is Somervell's story of our climb to 28,000 feet:

MR. SOMERVELL'S STORY

"The weather was looking more and more settled every day. On May 30, as Norton and I toiled up the glacier the third time this year to Camp III., we felt at last we were really going to be allowed a shot at the peak itself, and not merely baffled and foiled by a blizzard or hurricane at some comparatively low level. On June 1 we went up the steep ice-wall of the North Col with a few porters, and on arrival at the camp at the top of the pass heard that the other party had got off early, and were probably even then settling in at 25,000 feet.

"We slept well that night—beds of snow are much more comfortable than

those of the stores at the camp below. Early on the morrow we set out for the upper camp, six porters carrying extra food and bedding to replace what Mallory and Bruce would have taken up with them to a still higher bivouac. As we crossed over the snowy shoulder of the col to the windy western side the blast was most chilling. We drew our fur caps over our ears, tightened our belts, and went as fast as the altitude permitted, in order to keep warm. For though the sky was cloudless and the weather settled, Everest can provide on the finest day a wind chilling to the marrow. We had not been going long when Mallory and Bruce and their porters appeared above, coming down fast, an unexpected and unwelcome sight. They told us how they made a camp with two little tents, how the stoutest porter was sick, and the others unable or unwilling to go on. So there was nothing for it but to come back and hope for success of our attempt in the second of the series.

"Rather apprehensive as to the attitude of our own porters on the morrow, Norton and I plugged along up the easy scree on the shoulder leading for over 4000 feet from the North Col up towards the north-eastern summit ridge of Everest. We found Mallory and Bruce's tents pitched on the steep but sheltered south-eastern side of the shoulder. Keeping four of our porters in the camp, where they spent a very fair night in a space 6 feet by 5 feet, we then proceeded to settle down in the other tent of similar size. The floor had been well levelled by our predecessors, and, after making a good meal of pemmican and bully beef, coffee and biscuits, we spent a very fair night, during at least half of which we slept, finding no discomfort from the altitude or difficulty in breathing.

"Another glorious sunny day followed, and we were delighted to find three of the porters willing to proceed and carry loads, tent, bedding, and food to the next stage. One porter especially deserved credit, as he had cut his knee rather deeply on a stone the previous evening. The easy scree of yesterday became looser as we got higher, and energy as well as temper suffered in the weary plod from 25,000 feet to 26,700 feet, where the scree gives place to sloping slabs covered with small stones, which render footing rather precarious.

"We all found the views most attractive, not only for their magnificence, but as excuses for frequent halts. Indeed, halts were necessary as we went along, as they enabled us to keep breathing sufficiently for our bodily needs. Finally, at the height of 26,700 feet, in a rocky little basin on the ridge we had to stop and pitch our tent. The situation was far from ideal, but it seemed the best available in the vicinity, and on Everest you have got to take what you can get and be thankful. A lot of levelling had to be done, but the wind was kind, and, although by no means what we could have desired, the tent was at least habitable. The three faithful porters returned to Camp IV. quite fit, and armed with a note setting forth their prowess, and suggesting its reward with food at the lower camps, where no doubt they had the meal of their lives. In our tiny tent we cooked a good brew of coffee and a little soup, but the altitude was attacking our appetite and we could not fancy more than a morsel of solid food. Filling the thermos with coffee for the morrow, in order to avoid having to cook before an early start, we settled down for the night. Both of us were surprised that we got some sleep, at any rate, though not very much, but when morning arrived we were well rested and untroubled by breathing and other effects of great altitude.

"We got up full of hope as the dawn was breaking, but there was an early disappointment. Alas! the thermos had shed its cork during the night, and we had to waste nearly an hour melting snow in order to make more liquid. For both of us remembered how, in 1922, at a somewhat similar altitude, thirst,

above everything, destroyed stamina and going-power, and we were determined to start our final climb with plenty of fluid inside us. At last we got going about 6.45 a.m., and trudged slowly up a broad rocky shoulder slanting across towards our right in the direction of the summit, for there the going seemed easiest; moreover, in that direction was a patch of sunlight. Our side of the ridge was in shadow and very cold, and we thought climbing in the sunshine correspondingly attractive. At length, panting, puffing, and sometimes slipping back on the scree and compelled to stop for a minute to regain our breath, we attained the sunlight, and soon began to get warm. We crossed the snowy patch, with Norton gallantly chipping steps in front, and reached the broad yellow bank of rock which is such a conspicuous feature in distant views of the mountain. This rock has weathered into horizontal ledges some 10 or more feet wide, and provides a safe and easy route towards the summit ridge; so up these ledges we went, pulling ourselves, with heavy breathing, from one to another, and walking along them occasionally for respite, but always keeping upwards and to the right, hoping by these means to avoid some of the loose-looking rock on the north-eastern ridge above.

"But the altitude was beginning to tell severely on us. About 27,500 feet there was almost sudden change. A little lower down we could walk comfortably, taking three or four breaths for each step, but now seven, eight, or ten complete respirations were necessary for every single step forward. Even at this slow rate of progress we had to indulge in a rest for a minute or two every 20 or 30 yards. In fact, we were getting to the limit of endurance. At a level of somewhere about 28,000 feet, I told Norton I could only hinder him and his chances of reaching the summit if I tried to go any further, as an intensely sore throat added greatly to the misery of the fight. I suggested that he should climb the mountain, if he could, by himself, and settled down on a sunny ledge to watch him do it. But Norton himself was not far from the end of his tether. From my seat I watched him slowly rise, but how slowly, and after an hour I doubt whether he had risen 8 feet above my level. He realized that a successful issue to the fight was impossible, and after a little returned. We agreed reluctantly that the game was up. On the way to the summit was a patch of loose rock where it was desirable that two fit men should be roped together, but two men more or less "done to the world" were unable to hope to reach the top within a good many hours, and it was now 2.30 in the afternoon.

"So with heavy hearts, beating over 180 to the minute, we returned and retraced our steps; but slowly, for even downhill movement at this level is rather hard and breathless work, and both of us required frequent rests for regaining our breath and resummoning our energy. The view from the topmost point that we reached, and indeed all the way up, was quite beyond words for its extent and magnificence. Gyachang Kang and Chouyo, among the highest mountains of the world, were over 1000 feet beneath. Around them we saw a perfect sea of fine peaks, all giants among mountains, all as dwarfs below us. The splendid dome of Pumori, the finest of Everest's satellites, was but an incident in the vast array of peak upon peak. Over the plain of Tibet a distant range gleamed, 200 miles away. The view, indeed, was indescribable, and one simply seemed to be above everything in the world and to have a glimpse almost of a god's view of things.

"But we were far from being gods ourselves, tired and breathless as we were, the very epitome of human limitations. We revisited our high camp, and there packed our rucksacks and set off again downhill. We found the scree-covered slabs slow and annoying, and when we finally reached the snowy

shoulder at 25,000 feet, where going becomes easier, the sun had set, and we still had 2000 feet to negotiate in darkness. How well we remembered the same place in 1922, when we two, with Mallory, were exerting every effort to get down the invalid Morshead to the North Col alive, but this time I was the invalid, and my congested throat only allowed me to breathe at a certain and all too moderate a rate! I fear that my extremely slow progress must have annoyed Norton fearfully, though of course he said nothing about it. Flashes from our electric torch aroused the North Col to activity, and Mallory and Odell came up to meet us with lanterns while Irvine brewed tea and soup in camp against our return. How we welcomed their presence as supporters in camp and contrasted our experience in 1922, when four of us returned to an empty camp and went to bed with empty stomachs! This time we reached camp at 9.30 p.m. Within an hour we were fed, warmed, and fast asleep. Norton is still recovering from severe snow blindness, unfortunately contracted on the climb. I can almost speak aloud again. We are both rather done in, too, in general condition, but are satisfied that we had the weather and a good opportunity for the fight with our adversary. There is nothing to complain of. We established camps, the porters played up well, we obtained sleep even at the highest, nearly 27,000 feet, we had a gorgeous day for the climb, almost windless and brilliantly fine, yet were unable to get to the summit. So we have no excuse—we have been beaten in fair fight; beaten by the height of the mountain, and by our own shortness of breath. But the fight was worth it, worth it every time, and we shall cherish the privilege of defeat by the world's greatest mountain.

"We now await news of Mallory and Irvine, who to-day are making another attempt, hoping that they may reinforce the feeble summit air by artificially provided oxygen, and by its means be enabled to conquer the chief difficulty of reaching the summit. May the Genie of the Steel Bottle aid them! All of us are hoping that he may, for nobody deserves the summit more than Mallory, the only one of our number who has been at it for three years."

This ends Somervell's story.

The two attempts without oxygen failed to reach the summit. I hope to discuss later in your columns the vexed question whether success on these lines was possible or not. In any case, I was delighted to find on my arrival at Camp IV. on the night of June 4 that Mallory had rightly determined in my absence that there must be one more attempt, and that immediately and, if possible, with oxygen. Bruce, the condition of whose heart definitely prevented him from taking part in another attempt, had already gone down to Camp III. to see if it were possible to supply sufficient porters to put on oxygen so as to make the attempt with an absolutely minimum load. The men were forthcoming. Mallory had already decided that the climbers to make this final assault should be himself and Irvine. Unremitting and indefatigable work which had been put in by the latter on the most defective of the oxygen apparatus fully justified his inclusion in the party. On the morning of June 6 these two, with eight porters, started for Camp V., intending to sleep the following night at Camp VI. and to make the assault on the summit to-day.

Their movements are shrouded in mist and mystery, but one brief note reached us yesterday from their perch near the top of the North Ridge by the hand of a returning porter. It is to the effect that Noel, with the cinema, should be on the look-out for them about the base of the final pyramid that starts 650 feet from the top at 8 o'clock this morning. The returning porters

report that this pair were going exceedingly strongly with oxygen yesterday; from every point of view the situation is dramatic. One more small incident is worth noting.

During the night of June 4–5 on the North Col I was smitten with acute snow-blindness, and for sixty hours was completely and absolutely blind. At 10 a.m. on June 6 Hingston and two porters arrived from Camp III. to relieve and, if possible, escort me down. I was anxious to descend, as my presence at Camp IV. could only be an embarrassment to Odell and Hazard, who had now taken the place of Irvine in the *rôle* of supporters. Hingston, being unable to perform the miracle of restoring my sight at the moment, performed, with the help of Hazard and the two porters, another miracle.

The route to North Col is admittedly an Alpine climb. They shepherded me down some 1500 feet of sheer ice and snow, placing my every footstep, leading me by the hand, and supporting me with ropes, fixed and unfixed, with complete security. Hazard turned back after roping me from the top of the chimney to the bottom, and Hingston saw me the rest of the way into Camp III.

Hingston is a famous goer on a hillside and has a limited experience of snow and ice conditions in the Pamirs, but he has never done any Alpine climbing, so I think it must be admitted that his performance was remarkable, and it was certainly one that I shall not forget in a hurry.

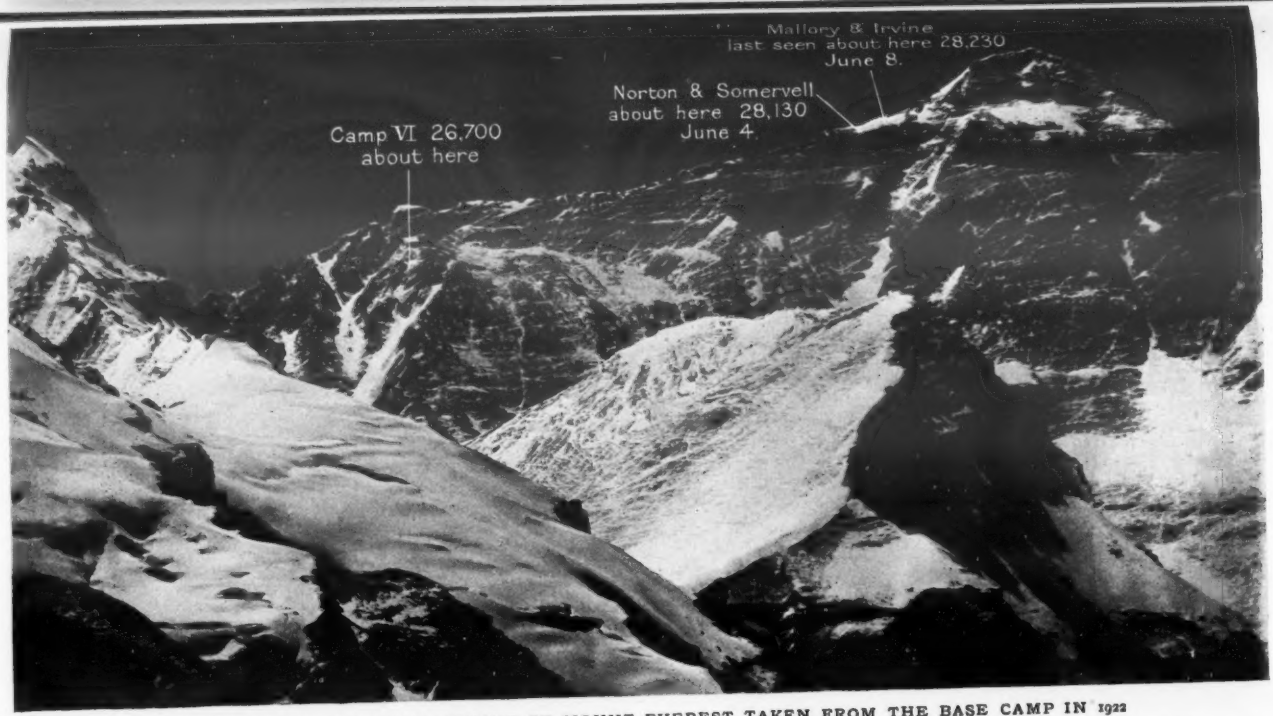
BASE CAMP, JUNE 11

With the deepest regret I add these few lines continuing the above dispatch. Mallory and Irvine perished on the mountain beyond all doubt. They were last seen by Odell from Camp VI. going strong for the top. I have not yet seen Odell, but estimate that this was about 11 in the morning of the 8th, and that the point reached at that time by the climbers was about 28,000 feet. Nothing has been seen or heard of them since. Odell returned to Camp IV. that night, and until about noon on the 9th the absence of news occasioned only anxiety, as the climbers might well have passed the night in Camps V. or VI.

At noon on the 9th Odell and two porters started from Camp IV. and spent the night at Camp V. About 1 p.m. on the 10th Odell reached Camp VI., whence he signalled that there was no sign of the missing men. Camps V. and VI. were under continuous observation by Hazard from Camp IV. throughout. These were provided with magnesium flares for distress signals, and there is no doubt that the climbers did not return to them. This puts any possibility of their survival out of the question, for no one could spend two nights on the mountain under existing conditions except in one or other of the two high camps and live.

The only likely explanation of the tragedy is that there was a mountaineering accident, unconnected with questions of weather or the use of oxygen. This is borne out by my own observations four days previously of the nature of the ground they were crossing when last seen. I remained at Camp III., directing operations by messenger, watching for a signal through the telescope, until 5.30 in the afternoon of the 10th, by which time I saw Odell reach Camp IV. safely. My condition and that of Captain Bruce, the only climber with me, precluded our reaching Camp IV. in time to be of any help, and, beyond a letter of instructions and the use of a system of signals, I had to give the supporting party in Camp IV. a free hand. They appear to have done all that was humanly possible.

Mallory & Irvine
last seen about here 28,230
June 8.



TELEPHOTOGRAPH OF THE SUMMIT OF MOUNT EVEREST TAKEN FROM THE BASE CAMP IN 1922

The points marked rest on an interpretation of Colonel Norton's dispatch No. 9. The point about 28,130 feet is believed to be that reached by Norton and Somervell together. Norton went on along some distance towards the summit, but gaining little in height: the relation of his highest point to the point at which Mallory and Irvine were last seen is not yet clear. The heights given by theodolite as 28,128 and 28,227 have been rounded off to the nearest 10 feet provisionally. They are referred to the summit as 29,002 feet.

Irvine Mallory Norton Odell Macdonald
Shebbeare Geoffrey Bruce Somervell Beetham
(Not in the group General Bruce, Hingston, Hazard, Noel.)

THE MOUNT EVEREST EXPEDITION OF 1924

I should add that I myself forbade any reconnaissance beyond Camp VI., as the weather was extremely threatening and conditions on the mountain appeared to be as bad as they could be, and I had to consider the lives of the two British and three Himalayan members of the Expedition who were still at or above Camp IV. I shall, of course, give you all details in my next dispatch.

NO. 9. RONGBUK BASE CAMP. JUNE 14
[PUBLISHED JULY 5]

The expedition leaves the Base Camp to-morrow, bound for a short period of recuperation in the Rongshar Valley, under Gaurisankar, before starting on its homeward march. The fickle weather, which has played so many dirty tricks this year, continues to be brilliantly fine, and there are indications that the monsoon has ceased for the moment. But there is no question of a resumption of hostilities on the mountain. Every one of the surviving climbers has shot his bolt. I have before me a medical report showing that each of us has a more or less dilated heart, besides various minor disabilities. The trouble will right itself at the lower altitudes to which we are bound, but would probably be permanent if further high climbing were attempted. This the medical officer [Major Hingston] definitely forbids.

There is yet another casualty to report. Man Bahadur, a Nepalese, the assistant bootmaker, who was very badly frost-bitten in the feet, as reported in my message of May 13, died of pneumonia at the base camp under Hingston on May 25. Perhaps it was merciful, as he would have lost both feet had he lived.

We leave here with heavy hearts, We failed to establish success, for who will ever know whether the lost climbers reached the summit before the accident which it may be assumed caused their death? The last point at which they were seen was determined by the theodolite as 28,227 feet—less than 800 feet from the top. Together with the height reached by Dr. Somervell and myself, which, measured by the theodolite, was 28,128 feet, these constitute a world's "record" for climbing with and without oxygen respectively.

But the price is out of all proportion to the results. Much will be written by those at home of both Mallory and Irvine in regard to the various departments in which they distinguished themselves. I shall only say a few words on how we knew them here. Mallory was for three years the living soul of the offensive on Everest. I believe the thing was a personal matter with him, and was ultimately somewhat different from what it was to the rest of us. The story of his determined, and ultimately successful, reconnaissance in 1921 is now well known. In 1922 he formed one of the party which reached 27,000 feet without oxygen and established what was then a world's height "record." This year he was earmarked for the first attempt with oxygen, but this was prevented by the weather. Then he took part in the first attempt without oxygen, but had to turn back at 25,000 feet. Only three days later he started on the last fatal attempt with oxygen, and this time who will say whether victory was at last his or not before he died?

We always regarded him as an ideal mountaineer, light, limber, and active, gifted with tremendous pace up and down hill, and possessing all the balance and technical proficiency on rock, snow, and ice which only years of experience give. But the fire within made him really great, for it caused his spirit constantly to dominate his body to such an extent that, much as I have climbed with him, I can hardly picture his ever succumbing to exhaustion. As a man

Shebbeare Geoffrey Bruce (Not in the group General Bruce, Hingston, Hazard, Noel.) THE MOUNT EVEREST EXPEDITION OF 1924

he was a very real friend to us all, a cultured, gentle spirit curiously contrasting with the restless, fiery energy he displayed in action. His loss is irreparable no less to his friends of the successive Everest expeditions than to the very much larger circle of those who loved him in England.

Irvine was described in an earlier dispatch by General Bruce as our "experiment," for he was a mountaineer of limited experience and twelve years younger than the average age of the expedition. But the experimental stage was short indeed, for it was a matter of hours rather than of days. The qualities which made him such a success when sledging in Spitsbergen brought him to the front; his first winter's ski-ing in Switzerland placed him, and the Oxford boat made all realize immediately that we had here no untried boy, but one of the most valuable members of the new expedition, and, what is more, one who could take his place modestly, but with absolute equality, with men of so much senior age. Then in no time his cheery *camaraderie*, unfailing good nature, and untiring mechanical ingenuity and resource made him not only valuable, but invaluable.

I do not know how we are going to get on without him. Physically he was the strongest of us. He did surprising feats in carrying and hauling loads; his times up some stages of the East Rongbuk Glacier were unequalled.

In my last dispatch I spoke of his work on the North Col in the *rôle* of supporter—a true test of a man's mettle, but nothing new to him, for ever since Khamba Dzong he had been working unremittingly and unostentatiously every day and all day for the good of the expedition and of its individual members. We mourn in him the loss of a true friend to every one of us, and a most gallant gentleman.

I have asked Odell to amplify his previous brief account of the final attempt and tell the story, as he took part in it from the position in support at Camp IV. His performance in climbing once to 25,000 feet and twice to 27,000 feet in seven days constitutes, I consider, a remarkable feat to be accomplished on Everest or on any other of the great Himalayan peaks. Perhaps more remarkable still is the fact that he suffered less than most other climbers in doing so.

It remains for me to say a few words about the evacuation of the glacier camps. Throughout you have heard little of Shebbeare, yet he played a most important part in them. After the first evacuation of Camp III. on May 11 it was decided that Shebbeare's knowledge of the language and of the psychology of the porters called for his presence on the lines of communication rather than at the Base Camp. Accordingly, he was established as king of Camp II. From that moment we at the higher camps never had to look over our shoulders or give a moment's anxious thought to our line of supply. Food for the sahibs and porters, fuel and stores of all sorts, arrived smoothly as required, and, more important still, we knew that the comfort and health of the porters on the lines of communication were well cared for.

When the time came on June 11 to evacuate all the camps from Camp III. downwards—the higher camps we decided to abandon all standing—Shebbeare took the matter in hand, and in three days, by good organization and the use of every porter who could carry a load, he had cleared to the Base Camp every single article the value of which justified transport home across Tibet. So smoothly was the operation performed under his skilful leadership that there is nothing to write of it.

Our one free day here before we finally leave this old Base Camp of conflicting memories, so bleak and inhospitable after the sunny plains of Tibet, so homelike and cosy after the far bleaker glacier camps, is fully occupied.

Every man that can be spared is at work arranging the loads for to-morrow's march, or employed on erecting a monument on one of the great conical moraine heaps which overlook the Base Camp to commemorate the names of those who lost their lives in the three Mount Everest expeditions.

Odell's story of the final attempt on Everest—and victory ?—is as follows :

MR. ODELL'S STORY

" Colonel Norton has requested me to relate the events connected with the last great climb of Mallory and Irvine, a climb a good many aspects of which I had the advantage of witnessing during a protracted period of eleven days, while acting in support at the North Col (23,000 feet). The duty of being in support, from meaning readiness to support at need any exhausted member of the party on the mountain, largely transformed itself into cooking and preparing meals for whatever climbers made the North Col Camp a place of call. This function kept us fully occupied, particularly as all the water had to be obtained by melting snow, snow that at this altitude was of an exceedingly dry and powdered variety.

" On June 6, following an early breakfast of fried sardines, joyfully acclaimed and moderately partaken of, Mallory and Irvine left the North Col Camp for Camp V. (25,000 feet), accompanied by five porters, with provisions and reserve oxygen cylinders. Yesterday, using oxygen, they had already ascended from Camp III., 2,000 feet below, in two and a half hours. They were highly pleased with their performance, which seemed to augur well for the final attempt on the mountain. The next day they ascended to Camp VI. (27,000 feet), which had been established by Norton and Somervell in a ' record ' climb three days previously. The same day I ascended to the supporting Camp V. Hazard at this time arrived at the North Col to replace me. Porters returning from Mallory that night were the bearers of a hopeful message in a note which said that they had only used the minimum oxygen up to 27,000 feet, and that the weather was perfect for the job. The latter I could well appreciate, for, looking out that evening from the little rock ledge on which the tent was pitched at Camp V., I saw that the weather indeed seemed most promising for the morrow.

" The situation of the camp was unique and the outlook a commanding one. Westward there was a savage, wild jumble of peaks, culminating in Cho Uyo (26,750 feet), bathed in pinks and yellows of most exquisite tints. Right opposite were the gaunt cliffs of Everest north peak, intercepting a portion of the wide northern horizon, of a brilliant opalescence which threw into prominence the outline of a mighty peak far away in Central Tibet : was it General Pereira's supposed rival to Everest ? Eastward, floating in the thin air, the snowy top of Kangchenjunga appeared, and lastly, the beautifully varied outlying Gyangkar range. Sunset and after at that altitude were a transcendent experience never to be forgotten.

" At early morning of June 8 it was clear and not unduly cold at such an altitude. The two porters I had brought with me to Camp V. complained of sickness and headache, and altogether I was not unthankful for an excuse to send them down to Camp IV. at the North Col, for I especially wished to be free during an ascent I was to make for as wide a geological survey of the mountain face between Camps V. and VI. as possible. Soon after I had started on my task banks of cloud began to form, which periodically immersed one in gloom, but the wind remained quite light for such an exposed ridge. Now and then there would be an accompaniment of sleet and light snow. I could see above me frequently during these squalls that there was a glow of light,

indicating clearness at a higher altitude, and hoped that Mallory and Irvine were above the mist.

"At 12.50, just after I had emerged in a state of jubilation at finding the first definite fossils on Everest, there was a sudden clearing of the atmosphere, and the entire summit ridge and final peak of Everest were unveiled. My eyes became fixed on one tiny black spot silhouetted on a small snowcrest beneath a rock-step in the ridge, and the black spot moved. Another black spot became apparent and moved up the snow to join the other on the crest. The first then approached the great rock-step and shortly emerged at the top; the second did likewise. Then the whole fascinating vision vanished, enveloped in cloud once more.

"There was but one explanation. It was Mallory and his companion moving, as I could see even at that great distance, with considerable alacrity, realizing doubtless that they had none too many hours of daylight to reach the summit from their present position and return to Camp VI. at nightfall. The place on the ridge mentioned is a prominent rock-step at a very short distance from the base of the final pyramid, and it was remarkable that they were so late in reaching this place. According to Mallory's schedule, they should have reached it several hours earlier if they had started from the high camp as anticipated. That they had encountered bad conditions and snow-covered rocks and other obstacles was likely. However, in my opinion, from the position in which they were last seen, they should have reached the summit at 4 p.m. at latest, unless some unforeseen and particularly difficult obstacle presented itself on the final pyramid. This seemed to be very unlikely, for we had scrutinized the last slopes with telescopes and binoculars and had seen that technically the climbing was easy. Perhaps the two most likely explanations of their failure to return were a fall or inability to reach camp before darkness set in. I rather incline to the latter view, and consider it very probable that they sheltered in some rock recess and fell asleep, and a painless death followed, due to the excessive cold at those altitudes.

"After the brief glimpse of the party above described I continued up to Camp VI., which was reached just as a rather severe blizzard started. The camp consisted of one small mountain tent perched on a ledge, backed by a step of rocks by no means conspicuous or easy to find. I brought up with me provisions for the camp, and, after placing them in the tent and sheltering for a while, I decided to go out in the direction of the peak along the mountain-side, in case bad weather should compel the party to turn back. I whistled and yodelled through the driving sleet to give the returning party the right direction, but soon realized that in point of time it was a worthless task, for they would still be beyond hearing even if they were returning. Perhaps they were right above the blizzard in sunshine. Within two hours the storm had blown over and the whole north face was bathed in sunshine. I searched the upper crag for another glimpse of the party, but nothing could be seen.

"In accordance with earlier arrangements suggested by Mallory himself, I returned to the North Col, and with Hazard kept watch till late for signs of the returning party. As they had not returned on the morrow, it was assumed that perhaps they were still sleeping at Camp VI., having reached it at a late hour the night before, but we were unable with field-glasses to detect any movement around the distant tent. At noon I decided to ascend to Camp V., stay the night, and proceed to Camp VI. the next day to ascertain if they had returned and whether help was needed in consequence of some mishap. I arranged a code of signals with Hazard, by means of sleeping-bags placed con-

spicuously on the snow in case assistance, medical or otherwise, should be required. Two porters again came with me to Camp V., but again they had to return to Camp IV. because of indisposition.

"After a very cold night I pushed on to Camp VI., this time carrying with me an oxygen apparatus, and also provisions for the missing party. I reached the tent of Camp VI. in the afternoon, only to find everything as I had left it two days previously, and as Mallory and Irvine had left it on the morning of their climb. Leaving the tent, I climbed some distance, and worked out along the face in the direction of their route, searching for some clue. But what hope was there on such a vast mountain-face? Weeks of diligent search by a party fully equipped for such difficult and particularly trying work at that altitude might not produce any result or unravel the mystery.

"At length, as the day was drawing to a close, I reluctantly gave up the search and signalled down to Hazard at the North Col, over 2000 feet below, that no trace could be found. Closing up the tent, and leaving it with the last relics of our lost companions, I made my way down the north ridge, having now and then to take shelter behind rocks from the violent and bitterly cold west wind and to restore warmth and prevent frostbite, and at dusk reached the North Col Camp, with its profound comforts and hot soup. The next day we evacuated the camp and the others in succession down to the East Rongbuk Glacier.

"Has Everest been climbed? Colonel Norton has referred to this question. It will ever be a mystery. Considering all the circumstances and the position they had reached on the mountain, I personally am of opinion that Mallory and Irvine must have reached the summit. At least they have established a mountain altitude 'record.'"

THE SURVEYS OF SIR AUREL STEIN: REVIEW

Memoir on Maps of Chinese Turkistan and Kansu, from the surveys made during Sir Aurel Stein's explorations, 1900–1, 1906–8, 1913–15.— **Aurel Stein, K.C.I.E.** With appendices by **Major K. Mason, M.C.,** and **J. de Graaff Hunter, Sc.D.** (Records of the Survey of India, vol. **17**.) Dehra Dun: Trignometrical Survey Office. 1923. $13\frac{1}{2} \times 8\frac{1}{2}$, pp. xvi. + 208. *Illustrations, and volume of maps and charts.*

THE Survey of India has recently completed the publication of Sir Aurel Stein's maps, compiled from the surveys of his three journeys in Central Asia, in 1900–1, 1906–8, and 1913–15. They are issued in a portfolio, which contains altogether:

(*a*) An index chart of the area surveyed.

(*b*) 47 maps on a scale of 1 : 500,000, each covering two degrees of latitude and longitude.

(*c*) 11 charts, showing on the same scale the various systems of triangulation upon which the topography is based. And (*d*) a sectional drawing of ground levelled from the lake-bed north of Kum-Kuduk to that east of Besh-toghrak.

Accompanying these sixty maps and charts, and as one of its series of Record Volumes, the Survey of India has published a memoir by the same traveller. In this account Sir Aurel states briefly the geographical work of each expedition, explaining the methods he and his surveyors employed, and some of the difficulties encountered. A second chapter divides the whole

area into sections, and describes the physical features of each. Chapter iii. contains some general observations on the map compilation and on the symbols used; and the last chapter gives detailed notes on each of the forty-seven maps, with lists of the observed latitudes of each.

Two appendices, by members of the Survey of India, follow. The first investigates the accuracy of the triangulation, and has a comprehensive list of all the triangulated stations and points in each sheet. The second discusses the auxiliary height observations. Forty-three pages are then taken up with a systematic index of local names; there is a general index; and lastly some thirty plates, giving nearly eighty illustrations of typical landscapes, reproduced at the Calcutta offices of the Survey of India, add to the interest of the volume.*

The memoir thus presents a summary of Sir Aurel's geographical results, shorn of all the archæological detail that attracted him and brought him back again and again to the scene of his triumphs. A student who wishes to discover at once the particular journey during which any area was visited, will find the index chart invaluable. The geographer or traveller will find a mass of detail on the maps, for by the judicious selection of a variety of symbols, Sir Aurel has managed to depict, not only the topographical features, but also the nature of the surface crust, and of the various types of vegetation, living and dead.

A glance at the index map shows the vast extent of ground covered by these journeys. From the Pamirs on the west to the northern headwaters of the Huang-ho of China is nearly 28° of longitude, or roughly 1500 miles as the crow flies. But a better idea of the magnitude of the surveys may be formed by noting that during the actual progress of the second expedition, there were no less than 488 shifts of camp with a marching distance of 8300 miles; while on the third, Sir Aurel himself, in spite of the loss of toes he sustained in 1908, and his riding accident in 1913, covered 7000 miles, and his surveyor, Lal Singh, probably more.

This short notice therefore cannot pretend to do justice to the work in the field. The traveller has himself described each expedition to members of the Society, and it will be sufficient to give a brief *résumé* of this published summary. In chapter i. the author describes in some detail the geographical work of each member. In his first expedition he was puzzled by the discrepancies of Johnson's map south of Khotan. He states how in his second journey he at last succeeded in unravelling the mystery, and corrected the topography of the Yurung-kash valley, which he traced to its ice-bound source.

The last two journeys were the most fruitful of Sir Aurel's expeditions. Here we see how each call was answered, how each section was made to fit the best—often the only—season when work was possible. The reader may wonder at first why the traveller returned so often to the same area. The reason was not always purely archæological. Frequently it was to extend some previous survey, which had been abandoned through lack of time or the necessities of life. But when the expedition returned, in almost every case a new route line was surveyed, so that the fitting of the various sections has gradually produced large areas of completed map.

Little by little the uncharted recesses were traversed. The sandy wastes of the Takla-makan were crossed and recrossed. The Lop Sea bed and

* The 'Memoir' is also published without a complete folio of maps. In this case the Index Map, triangulation charts, sectional level drawing, and a specimen map are included in a pocket at the end.

Turfan depression were surveyed and levelled. The Emperor Wu-ti's ancient wall, with its watch-towers and fortified posts of the second century B.C., was traced for seven degrees of longitude. The Hindu-tash pass was crossed, and the Pusha and other hidden valleys of the K'un-lun revealed. The four parallel ranges of the Central Nan-shan, previously visited by Potanin, Obruchev, and Kozlov, were explored in detail. The headwaters of the Huang-ho were reached, and the Etsin-gol and Su-lo-ho traversed and mapped. In the north, the southern ranges of the T'ien-shan, the arid Kuruk-tagh and even the moist upland grazing-grounds of Dzungaria were surveyed, while on his last journey Sir Aurel broke entirely new ground by visiting the frontier Dard republics of Tangir and Darel, the full story of which has not yet been published.

In his second chapter, the author reduces this chaos to order. He separates the desert from the mountain, the arid from the moist, the heat from the cold, the living from the dead, the past from the present. He explains the principal features of the Tarim basin, comprising the Takla-makan wilderness of sand, the prehistoric dried-up Lop Sea bed, the dead settlements and terminal oases by the dying rivers. He passes to the gravel glacis, to the arid spurs, and to the snow-bound summits of the basin's rim. He describes each part in brief detail, and though the memoir is not intended to be a systematic treatment of geography, he has given an extremely clear description of each main feature.

Chapters iii. and iv. require little comment. The writer of this note was responsible for Appendix A. In the same way and with the same gentle persuasion that Sir Aurel employs with all associated with him, I was asked to investigate the triangulation. I can only say that the preparation of this appendix, dull as it must appear in print beside the traveller's own chapters, afforded to me the utmost interest. As a result and with Sir Aurel's consent, I have included in the lists all triangulated points in the area of his travels, whether fixed by his or previous expeditions. They are now given with their dates, observers, and relative order of accuracy.

There is one point in this connection, to which attention must be drawn. In certain sheets the triangulated coordinates of some points do not agree with those on the map sheets. The discrepancy is due in the first place to an error of identification during the field-work of R. S. Lal Singh, and in the second to the assumption in the Dehra Dun office that the error at the Korla end of the triangulation was due to a systematic accumulation of error, instead of one mistake. This led the office to distribute the error somewhat arbitrarily. It is one more pity that must be laid to the fault of the Great War, for had it been possible to consult Sir Aurel Stein, it is probable the significance of the mistake would have been made clear. As it happened, it was not till my re-investigation of the triangulation that an error of identification during the field-work was discovered. On pp. 35, 36 the author describes the great difficulties and hardships of Lal Singh in the Altmish-bulak area. The surveyor waited for nearly a fortnight under most disagreeable conditions of extreme cold and exposure, with an inadequate supply of water, in the hopes of getting a connection over a distance of 130 miles of haze to a single fixed peak of the K'un-lun. When at last he saw a small section of the range he had a glimpse of a peak which answered his mind's picture recorded 15 months before, when seen from an entirely different angle.

This identification was almost certainly wrong, and the link here has been rejected, but its consequences—the distribution of an assumed systematic

error—have shown themselves on some of the maps. In the lists now given and in the charts, the two sections of Lal Singh's work are published without correction. In the south the triangulation is continuous to Pk. 1/75 E, while the northern section between Korla and Astin-bulak is based solely on Clementi's value of the former place. The matter is discussed in Appendix A, while in the lists the incorrect map-values have been given in italics below the revised co-ordinates of each point.

In Appendix B, Dr. de Graaff Hunter compares the height results obtained by mercury and aneroid barometers and hypsometers. The first were good, the second surprisingly so, while the hypsometric heights proved valueless. Dr. Hunter discusses the reason for this failure and describes shortly the process of reduction.

Sir Aurel Stein's systematic record of local names should prove of great value. Whatever system of transliteration is eventually used internationally for this area, a complete list of all names on one system is an immense step forward. The maps of Central Asia, particularly those published by Russia, at present appear to follow no method in this respect, and though perhaps the use of many accents is disliked by some, they undoubtedly assist in the correct pronunciation of names.

The interest of the volume, especially that of the first two chapters, is much enhanced by the careful selection and excellent reproduction of the author's own photographs. These are collected together at the end of the volume and give a vivid idea of the various types of country surveyed.

Throughout his journeys, Sir Aurel Stein has been accompanied by surveyors lent by succeeding Surveyor-Generals. These have maintained throughout a very high standard of excellence in their topographical work. It is a great pleasure to read the leader's glowing tributes which he pays to all who worked with him in those inhospitable deserts and mountains. Sir Aurel brings many admirable qualities to his assistance in his capacity as a geographer. Not least of all these may be counted his fixity of purpose, his gentle persuasion and boundless tact in achieving a desired result, and his unstinted gratitude to all associated with his work, whether British, Indian, Chinese or the wild men of the Afghan borderland.

K. M.

THE MAKING OF A MOUNTAINEER: REVIEW

The Making of a Mountaineer.— G. I. Finch. London: Arrowsmith. 1924. 10 × 6¼, pp. 340. *Illustrations and Diagrams.* 30*s. net.*

THIS substantial volume is the record of the *tours de force* of one of the most competent representatives of the advanced school of modern mountaineering; the climbers to whom the chief attraction of a climb is in its difficulties and in the test they afford of their own powers in coping with them. Captain Finch has been at pains to describe the struggle between man and mountain with an amount of personal and technical detail which will doubtless prove interesting to his fellow-experts in the craft. Two hundred and forty out of his three hundred and forty pages are devoted to the incidents involved in some of the most formidable expeditions in the Alps; such as, for instance, the ascents of the Dru and the Chamonix Aiguilles, of Mont Blanc from the South, of the eastern face of Monte Rosa, the northern face of the Dent d'Hérens and the traverse of the Matterhorn. The story of the last, excellently

told by Mrs. Finch, gives a very vivid picture of the impression made on a fresh mind by the tremendous crags and cliffs of the grim Zermatt mountain.

For some years a student in Zurich, Captain Finch soon became one of the leading spirits of the Academic Alpine Club of that city, a body who pride themselves not only on performing feats of endurance and agility, but also on dispensing with the aid of guides. We do not impute any blame to them in this respect, for a youth who, living close to the mountains, has been able to practise on them from boyhood is naturally inclined to trust to his own experiences; in fact, he is mainly differentiated from a guide by climbing for sport and not for his livelihood. But Captain Finch might have remembered in his retrospect that the case was very different with the first generation of our countrymen who set out to climb by themselves or—a far more questionable proceeding—to teach, unaided, mountain-craft to English schoolboys. On a kindred point, the absence, during the latter half of the last century, of more than a handful of first-rate professional guides, we—with some experience—agree with Captain Finch. The risks run in company with incompetent guides and the accidents due to them have been, we think, as a rule underestimated. We agree also with Captain Finch in his opinion that the greatest guides have had (in the Alps, at any rate) no equals among amateurs in the combination of daring and judgment which is as essential a quality as gymnastic force in the forming of the perfect mountaineer.

Captain Finch is an expert not only in climbing in the ordinary sense, but also in winter sports, and he here describes at length several of his adventures on ski in the heart of the Bernese Oberland. He differs from many of his contemporaries in recognizing that rock-climbing is not the only form of mountaineering, but is surpassed in the qualities called forth by the snow and ice-craft in which the great guides of the last century conspicuously excelled. We commend the following sentences to those whom they may concern. "In fine, as a training-ground for snow and ice-craft, our homeland hills are useless . . . ; there are some British rock-climbers who contend that snow and ice-craft is no more difficult than rock-climbing. In reality there is not one of the big snow and ice expeditions of the Alps that does not represent a far more serious undertaking, physically and mentally, than the Grépon, Requin, or any other of the better known 'crack' rock climbs. . . . Rock-climbing is too liable to strangle any innate aptitude for mountaineering proper, and to restrict achievement in the wider craft to a level of dull mediocrity" (pp. 265–7). What is true of the Alps is *à fortiori* true of the Caucasus or the Himalaya with their far more complicated climatic conditions.

An account, written by a brother of the author, of a winter ascent of the Tödi, the monarch of the mountain group nearest Zurich. the heroes of which were benighted on the glacier and severely frostbitten, proves that the Swiss students gained their experience, at times, at the cost of their extremities; while the attack on the steepest ridge of the neighbouring Bifertenstock may strike even climbers as touching, if not transcending, the limit of sane adventure. From the pages in which one perilous situation after another is described and then brought before one's eyes in the thrilling photographs with which the volume is liberally supplied the general reader may turn for variety to the description of an Easter holiday spent among the mountains of Corsica, the granite crags that look down on the forests of Evisa and the blue bays of the Mediterranean. In the final chapter he will find an account of the leading part taken by Captain Finch in the 1922 assault on Mount Everest. The story of that gallant adventure, the author's and Captain Bruce's climb

to 27,300 feet, is once more vividly told. We are led to realize how skilfully the crisis caused by the partial breakdown of the oxygen apparatus was met; how, weather-beaten and half-starved, the two climbers fought their way literally to the last gasp.

Two questions are raised by Captain Finch, the discussion of which must now of sad necessity be postponed. It is well known that he and Mr. Leigh Mallory took opposite views as to the expediency of using oxygen. On this point the experiences of the 1922 climbers were not conclusive. It was shown that a height of 27,000 feet can be reached without the help of oxygen, while the weight of the apparatus proved obviously a serious handicap, and its liability to get out of order a possible danger. On the other hand, the relief that oxygen gives from the exhaustion caused by altitude was forcibly demonstrated. There until the full story of this year's tragedy has been told the matter may be left. Now that 28,000 feet has been reached without oxygen the cases in which it need be resorted to are few indeed.

Again, Mr. Leigh Mallory (see 'The Reconnaissance,' p. 232) stated his conviction that the North East Ridge of Mount Everest is inaccessible, or at any rate useless as an access to the summit. Captain Finch here puts forward an opposite opinion, citing Mr. Raeburn as an authority for his view; but Mr. Raeburn's nearest approach to the mountain was apparently the 20,000-feet camp at the head of the Kharta valley, and he does not seem to have visited the Rapiu La, the nearest point to the ridge in question.

Captain Finch's pages call our attention to the growing habit among modern mountaineers of reducing the number of the climbing party to two. This has only been rendered possible by the preference for rock-climbs shown of late years. In glacier expeditions it is, of course, suicidal. So long as all goes well two practised rock-climbers need not necessarily require a third, and may even move more rapidly without one. But let any illness, or crippling accident, occur, the position of two men becomes at once critical. The sufferer must be left alone until his comrade can procure aid. There seems no ground whatever for modifying the opinion expressed over and over again by very competent critics in the Badminton volume on 'Mountaineering' that a party of less than three is exposed to additional and very serious risks. A long personal experience urges the present writer to endorse a verdict that has of late been insufficiently respected.

It is the author's fault if in laying down his volume we feel bound to class it rather with the literature of sport than with that of travel. The personal incidents of mountain climbs, repeated one after another, if more dramatic than those of rounds of golf, have except for enthusiasts a like inevitable sameness. Captain Finch has an eye for scenery, and a feeling for the heights, and he knows how to convey his impressions to his readers. He could, we are confident, give us an agreeable volume of mountain experiences, but—and this perhaps indicates the weak point of the gymnastic climber—he has, in writing the present volume, been so absorbed in the constantly recurring struggle against gravity that the effect of the natural environment has been subordinated to the figures in the foreground.

The volume lacks an index.

D. W. F.

REVIEWS

EUROPE

The Roman Occupation of Britain: being six Ford Lectures delivered by **F. Haverfield**, now revised by **G. Macdonald.**— With a notice of Haverfield's life and a list of his writings. Oxford: Clarendon Press. 1924. 9 × 6, pp. 304. *Illustrations and Sketch-map.* 18*s. net.*

THESE lectures, originally delivered in 1907, the author had begun to revise before his death, and they are now admirably edited, with a notice of Haverfield's life and a list of his writings, by Dr. George Macdonald. Their general contents will be familiar to the reader of Haverfield's 'Romanization of Roman Britain.' The lectures deal with the Study of Roman Britain, I.; the Geography of Britain and the Roman Conquest, II.; the Permanent Military Occupation, III.; the Civilization of the Province, IV., V.; and Roman Britain and Saxon England, VI. From the geographical point of view Lecture II. on the geographical conditions which affected the Roman occupation is naturally of most importance. The author claims that it is "an abbreviated exercise" in historical geography, following the method of first studying so far as is necessary the physical features, and then deducing their influence. The outstanding feature of the book is the help it gives to the modern mind towards realizing what it certainly finds very difficult to realize, that Roman Britain was not what this island was, at times, in the Middle Ages—a small self-contained state, but a part of an enormous whole, and that the *mare dissociabile* of the Straits of Dover was rather a bridge than a barrier. It must be remembered that Britain, though an island, was firmly linked to continental Europe, belonging closely to the opposite mainland. "The two together form one vast flat-bottomed valley . . . which slopes slowly up from the sea to the Derbyshire and Welsh hills on the north-west, and on the south-east to the succession of ranges which connect the Auvergne and the Eifel." This fact once seized, and modern racial and political divisions discarded, it becomes more possible to conceive a "Celtic" civilization which once covered the whole region between the Rhine and the Atlantic. Coins of tin and copper and gold serve to remind us that pre-Roman Gaulish princes reigned on both sides of the Straits. Of this geographical unit a consequence is that "each side of the valley still lies exposed to attack from the other." The easily invaded area of England is in the east, near the bottom of the ancient river valley. Hence the tide of invasions which generally flowed from continent to island, but sometimes, as from 1066 to 1558, from island to continent. The island is also conspicuously divided into uplands to north and west, and lowlands to south and east. Two of Haverfield's rough generalizations are helpful: first, a line drawn from York through Derby to Chester, and from Chester through Shrewsbury to Gloucester, bounds the two areas; second, the lowland is mostly lower than 600 feet, and contains few strategic points, one being London. "London is the greatest expression of the primeval geographical bond between England and the opposite lands." The uplands lie scattered in three great pieces—Devon and Cornwall, Wales, and Northern England. Pages 89–99 contain the gist of the matter and set forth the essential physical features which determined the history of the Roman Conquest and of the military occupation, sketched respectively in pages 100–124 and 127–170. To Haverfield must be accredited these characteristic and useful broad conceptions, which figure also in the 'Romanization of Roman Britain,' but are set out here more fully. S. E. W.

The Roxburghshire Word-book : being a record of the special vernacular vocabulary of the County of Roxburgh, with an appendix of specimens.— **George Watson,** of the staff of the Oxford English Dictionary. Cambridge University Press. 1923. 9 × 6, pp. viii. + 344. 20*s. net.*

This scholarly achievement is published as a special number of the *Transactions of the Scottish Dialects Committee*, under the general editorship of Mr. William Grant. It contains a few topographic terms, but its scope is of course general. It will take its proper place as a standard work of reference. Mr. George Watson is to be congratulated on the results of his industry, which is of the kind that has long been associated both with Roxburghshire and the Oxford English Dictionary. O. G. S. C.

The Nations of To-day: Belgium and Luxembourg.— G. W. T. Omond. London: Hodder & Stoughton. 1923. 9 × 6, pp. xviii. + 263. *Maps.* 15*s. net.*

In some respects this volume has advantages over others in the same series. First, it is entirely the work of one writer. Mr. Omond, again, has interpreted his task rather narrowly, for, with the exception of the first thirty-four pages, he devotes himself to the history of Belgium and Luxembourg after 1830. Thus the book possesses a character and unity of its own. On the other hand, pre-war and post-war diplomacy occupies too prominent a place in its composition. More space might have been given to developing at greater length the reasons for the fundamental differences between Holland and Belgium, and for England's, and Europe's, continued interest in their fate ; this, after all, should be the main purpose of the historical introduction. After 1830 Mr. Omond is very much at home with his subject. The growing wealth of the community consequent upon the resources of coal and iron, and, at the same time, its increasing helplessness from a military point of view owing to domestic optimism and the international situation, are well brought out. The events of the war period are detailed, and recent developments in internal and foreign relationships are discussed very clearly, from the author's standpoint. The chapter on "Economic Resources, Finance and Trade," helps to explain the rapid recovery Belgium has made from her war losses. In a section headed "Miscellaneous," and following upon a note on Defence, there are a dozen pages devoted to "The Men of Letters."

Kleine Pflanzengeographie der Schweiz.— Dr. Ernst Furrer. Zürich: Beer & Cie. 1923. Pp. viii. + 331. *Illustrations. Frs.* 8.

This book is intended for teachers and students, as well as for lovers of nature generally, and contains a fairly comprehensive account of the plant geography of Switzerland, treated on modern lines. As one would expect, a considerable amount of space is given to the woodlands, and there is a useful figure showing the distribution of forest, cultivated land, and waste ground in the country, according to cantons. The figure brings out well the amount of woodland in the Jura, as compared with the areas in which deforestation has been more marked. The discussion of the causes leading to the progressive loss of ground by *Pinus cembra* is also interesting. Dr. Furrer is inclined to think that man is the greatest enemy of this species, but its heavy edible seeds are a handicap in the struggle for existence as compared with the wind-borne seeds of the other common conifers.

There are a number of illustrations from photographs, some of great beauty, though the reproduction occasionally leaves something to be desired, and also many diagrams. There is, however, no list of figures, and the index is a little inadequate.

The Agrarian Revolution in Roumania.— Ifor L. Evans. Cambridge University Press. 1924. 9 × 5½, pp. xvii. and 197. *Two Maps.* 12*s.* 6*d. net.*

Mr. Evans considers that the Agrarian Reform movement which has swept over Eastern Europe since the Russian Revolution forms one of the greatest social upheavals of modern times. Since present conditions in Russia make it impossible meantime to consider the effects of the changes in land ownership and distribution there, he has selected Romania as the basis of a preliminary study. He states also in his preface the sound principle that it is imperative that the Agrarian Revolution in Romania should be judged in terms of the history and geography of the country. Turning to the text, however, we find that while the historical aspect receives full consideration, both in the old kingdom and in the new territories, the geography of the whole area is dismissed in a brief introduction of less than three pages. These pages have no references, though the literature relating to Romanian geography is fairly extensive, and the very important subject of climate is dismissed in a paragraph containing some rainfall figures. This absence of an adequate treatment of climate and relief tends to give an air of unreality to parts of the discussion of agricultural economics, and not all the statements made will command general acceptance. Thus when the author states that in agriculture "nature itself is the real producer and . . . labour must of necessity take a second place," he seems to overlook the fact that the value of most crop-plants is due to qualities which are either a direct handicap or at least no advantage in the struggle for existence. Far from Nature being the "producer," she is constantly tending to eliminate. Nor can we reconcile the statement that large-scale organization is at a disadvantage in dealing with such crops as sugar-beet, with the conditions which determine the world distribution of that crop.

The book obviously represents an enormous amount of work, especially on the historical and statistical side. The most general conclusion which emerges is that which has been already emphasized by others, that the dividing up of the large estates is tending at present to lead to a reduction of the area under wheat as compared with maize.

Though, as already stated, the book is not directly geographical, it contains a mass of material of which the geographer can make much use, and should be noted on this account. M. I. N.

ASIA

A Palestine Note Book (1918–1923).— C. R. Ashbee, M.A. London: William Heinemann, Ltd. 1923. 9½ × 6, pp. xiv. + 278. *Illustrations.* 12*s.* 6*d. net.*

Invited by the Military Administration of Palestine to report upon its Arts and Crafts and to help in the new plans for the reconstruction of the city, the author of this book spent some four and a half years in Jerusalem. His very varied impressions, his likes and dislikes, his changing moods, and his many discussions on the burning local questions are here fully recorded. Through the mouths of his friends "an intrepid Zionist, an intelligent Moslem, an impartial British official, a Greek aristocrat, and an impertinent free-lance," the writer lays before us with a pleasant if somewhat flippant cynicism the clashings of opinion in the early days of the British Occupation. For Orthodox Christianity—Greek, Roman, and Protestant—there is nothing pleasant said. The finest sentiments are uttered by "Shaikh Isma'il al Khaldi," and the writer's bias is strongly in sympathy with the Moslem majority.

The pen portraits of many who were present in the early days are sympathetic and true. Most will agree with Mr. Ashbee in his abhorrence of "the futile and undesirable hope of establishing an industrialized Palestine." "May it not be better to leave as it is that peasant Society, which has so much dignity and beauty, if what we displace it with is the discontent and squalid ugliness of south-eastern Europe Americanized?"

The writer's attitude is challenging, and his notes are so full of humour that all who are interested in modern Palestine will enjoy perusing his pages.

E. W. G. M.

East Persia: a backwater of the Great War.— Brig.-Gen. W. E. R. Dickson, C.M.G., C.I.E. London: E. Arnold & Co. 1924. 9 × 6, pp. viii. + 279. *Illustrated.* 15*s. net.*

Some stern critics during the Great War never ceased to anathematize the "side show," and not without good reason in many cases. Yet, in the wilds of Asia, a handful of British officers, who were prepared to make bricks without straw, time and again achieved results with the tiny forces they commanded, out of all proportion to the expenditure of blood and treasure that was involved.

In each case knowledge of the language and country, a readiness to look at things from the native point of view, a keen sense of humour, and, above all, British fairness won the day. General Dickson possessed the signal advantage of having lived at Tehran as a boy, and his intimate knowledge of the Persian language and mentality stood him in good stead when he was ordered to Eastern Persia.

Previous writers have shown that when the Russian army collapsed in the winter of 1917–18, the way to India across Central Asia and Persia lay open. The British Government showed much resourcefulness in its attempts to parry the danger by the organization and despatch of "Dunsterforce" to Baku, by commissioning some merchant vessels on the Caspian and by the despatch of a military mission under Sir Wilfrid Malleson to Meshed with instructions to help the Turkoman and other anti-Bolshevist elements in Central Asia. But before the last-named mission appeared on the scene, General Dickson was appointed Inspector-General of Communications of the East Persian Cordon, whose task was to prevent German Missions from entering Afghanistan across Persia. But he was soon appointed to command the line of communications that was organized for General Malleson's force, which operated with great success and signal credit in Transcaspia, while he prepared everything for a much larger force, had a Turko-German army advanced across Northern Persia as at one time seemed possible.

The book must be read to realize his difficulties and the courage and resourcefulness with which they were overcome. The climatic changes were great, water was scanty and bad, and supplies were always hard to collect. On the other hand, the railway was constructed across the desert from Nushki to the Persian frontier at Duzdab, and a road fit for motor lorries was opened up to Meshed. It is interesting to read how the hostility of the people was overcome by tact and friendliness, so much so that when the troops were withdrawn deep regret was expressed.

In the British press the alleged extravagance of the building operations was unfavourably commented on. Actually much can be done very cheaply with sun-dried bricks, and, had the troops been billeted in the villages, their health would have suffered, and that very seriously. General Dickson only did his duty in providing against these contingencies. Needless to say, the

country was surveyed and also studied from many points of view, and, as elsewhere in Persia, its communications have been permanently improved. Not that there was no opposition. Milestones were disliked on the high moral ground that they produced impious thoughts and made the wayfarer apt to rely on himself rather than on Allah for reaching his goal. Again, the white-wash with which they were covered was scraped off and swallowed as a specific by barren women! However, British energy triumphed over all obstacles, and finally a road for motor transport was opened up from railhead on the frontier of Persian Baluchistan right up the eastern frontier to Meshed and Askabad, while the Lines of Communication were carefully organized.

The book makes interesting reading for the general reader, while much light is thrown on conditions of life and the prospects of trade in this remote and barren land. P. M. S.

AFRICA

El Raisuni, the Sultan of the Mountains.— Mrs. Rosita Forbes (Mrs. MacGrath). London: Thornton Butterworth. 1924. 9 × 5½, pp. 322. *Illustrated.* 21*s. net.*

Whether one agrees or disagrees with Mrs. Forbes' valuation of that remarkable person, Raisuli—whether one accepts or dismisses the explanations which he himself places on his motives and actions, this volume must become an essential authority for the student of Morocco to consult. It is certainly a most valuable contribution to the knowledge of that world which the author has set out so adventurously to examine. But the book will appeal to the student and to the general reader in different ways.

To the uninitiated, the first part of Raisuli's account of his life, which the author affects to describe as far as possible in his own words, is perhaps a trifle confusing. The story jumps from incident to incident with truly oriental disregard for times and seasons. Up to the coming of Spain to Larache, no dates are given on which to hang the sequence of events. In what may be termed the modern period, this fault is less manifest, but is not repaired in full. A mistake seems to have crept in (p. 192) where the intrigues of Sidi Abselam Tazi are referred to November 1915 during Silvestre's occupation of the Sahel Haman; it is clear (from pp. 198 and 204) that they must have taken place before, for the Peace of Khotot was signed in September 1915, by which time Silvestre and Marina had already been replaced by Jordana and Villalba. The complicated relations of Raisuli with Spain, France, Great Britain, the Sultans of Morocco, the Beys of Tangier, and other notables in that land of international intrigue, would have been easier for the general reader to follow had the author given us a short introduction on the political history of Morocco during the last fifty years, or at least had she commented at rather greater length on certain aspects of Raisuli's story. Mrs. Forbes could readily have done this, as she had access to, and in certain passages did make free use of, the diary of Mr. Rattigan, who was for some time at His Majesty's Legation at Tangier.

For the student the book contains a number of controversial issues, on which any one may hold his own opinion. However correct it may be, it is surely somewhat unnecessarily pedantic to call the man Raisuni, when all Europe has known him for over a generation as Raisuli. The author and he have of course combined to put the best interpretation on his activities. A less idealized picture would have shown that much of his initial success as well as his ultimate failure have been due to his constant breaches of faith,

both with Spain and with his own folk. Is any Moslem really to be defended for inviting the Christians into his country? And having done so, can Europe respect a man who twice broke faith with Spain? Force of circumstances and desperation may in a measure excuse his treachery, but does it quite fit in to the picture of the strong, honest, single-minded man? We are warned not to set ourselves up in judgment on Raisuli's (in our eyes) appalling cruelty; so also we must perhaps refrain from calling to account his good or bad faith, and consider only his success or failure. He is made to say (p. 103): "You cannot make good Europeans of us, but you can make bad Arabs." Then Europe has made of Raisuli a bad Moslem. For all Mrs. Forbes' efforts to the contrary, one must end by feeling that he has been a bad and not very successful man. He has had to bow his head. Is it for the last time? The author evidently thinks not; but one may be permitted to take the opposite view. He has lied once too often.

Raisuli and his people are surely not Arabs; the genealogy tracing his descent from the Prophet is as fictitious as that of Berbers in Morocco whose blood in many cases, for all that they claim to be Ashraf, is as free from admixture with the Arabs as that of families in England. Raisuli is a Berber, descended from those people who defended Africa so well against the Arabs and who held the country for centuries before the rise of Islam. People are too fond of thinking that Arab and Moslem are synonymous terms in the Near East. There is another detail which has gone wrong; the name on p. 17 and elsewhere is spelt Mannesmann and not Mannismann, and there were three brothers working as German agents in North Africa during the war. They belonged to the firm at Agadir whose interests the *Panther* was sent to protect in 1909, with results that are well known.

But these errors are trifling and unimportant, for the student will realize them at once. They do not much impair the value of the book, which contains a striking picture of an interesting personality, full of the warmth and colour of the East which Mrs. Forbes knows so well how to appreciate. It is a great pity that so interesting a book should have been so badly produced, but for this the publisher is no doubt to blame. F. R.

In Brightest Africa.— Carl E. Akeley. London: W. Heinemann, Ltd. 1924. 9 × 6, pp. xviii. + 267. *Illustrated.* 21*s. net.*

Mr. Carl Akeley was a typical American boy who has risen to prominence in the United States as a taxidermist. He made three expeditions to East Central Africa, the first in 1905, the other two in 1911 and in 1920. On the last expedition he devoted his energies more especially to obtaining five (or more) adult specimens of the great Gorilla that frequent the range of snow-tipped volcanoes nearly under the equator, in the borderland of East Africa between the basins of Tanganyika, Victoria, and Albert Nyanza. He felt bound to shoot these five (or more), but was afterwards filled with something like remorse for a deed which savoured of murder—very nearly.

As a gorilla-killer he was followed by Prince William of Sweden, who shot fourteen at least, and by Mr. Alexander Barns (if Barns did not precede and succeed him). And Barns shot several more. Then there were other sportsmen from Uganda less remorseful about killing gorillas, and earlier still the Germans from what was then German East Africa, who were more or less the first in the field to obtain specimens of this East African sub-species, the largest form of gorilla known.

I write "more or less," because it was really earlier still, through Belgian officers in the Congo Free State service, that we definitely heard of the East

African Gorilla. The writer of this review was in Uganda and the Congo forest in 1900, and there was shown by Belgian officers in the Ituri District photographs of dead gorillas which were alleged to have been killed by native hunters in the forests lying between the upper Ituri River and the main Congo. They did not apparently come from the extremely elevated region—heights between 8,000 and 11,000 feet—on the upper slopes of the volcanoes of Mfumbiro, but from the hills and mountains of much lower elevation bordering the Upper Congo in its north-easternmost bend. Is this form of gorilla, from near Stanley Falls, the same sub-species as the giant gorilla (*Gorilla gorilla beringeri*) from the Mfumbiro or Mikene region ; and is this again identical with the gorilla shot by George Grenfell at Bwela, Motima River, near the north bank of the Congo River, in 1905? Bwela, where Grenfell reported a troop of gorillas and shot one of their number, is almost exactly midway in range between the Stanley Falls on the east and the Sanga River on the verge of the Cameroons district in the west.

The main Congo River seems by a cumulation of evidence to act and to have acted as a complete boundary southward and westward over the range of many remarkable mammals, a few birds and reptiles, which have otherwise ranged unimpeded over Equatorial Africa. Again, not a few of these creatures like the okapi and the gorilla appear never to have crossed the Congo westward in the extension of their range, or to have passed westward of the Cameroons.

Mr. Akeley, having killed his specimens of remarkable beasts for storage in American museums, now pleads for mercy, especially so as regards gorillas, the slaughter of which seems, as he portrays it, uncommonly like murder. But will his appeal to the White or Black man have any or sufficient effect? The writer fears not. There is a type of "sportsman," still too common as the above facts prove, that will never be satisfied until all the remaining remarkable beasts are no longer there to be killed. Mr. Akeley refers to the remarkable illustrative work of Mr. Radclyffe Dugmore's and Mr. Alexander Barns's cameras, and hopes such a line vigorously followed will provide enough excitement for the rising generation. But his present reviewer cannot share his hopes. When he peruses (and grinds his teeth over) the "big-game" advertisements of the Sudan—either Government or commercial—and remembers how of late the Sudanese officials and Natalian farmers have been shooting down the White Rhinoceros so as to bring it to the very verge of extinction in Zululand and the Bahr-el-Ghazal, he has little hope of any Government being strong enough to restrain the slaughterers from exterminating the giant gorillas from the East African mountains. H. H. J.

The Black Republic, Liberia : its social and political conditions to-day.—H. F. Reeve, C.M.G. With an introduction by **Sir Alfred Sharpe, K.C.M.G., C.B.** London : H. F. & G. Witherby. 1923. 9 × 6, pp. 207. *Illustrations.* 10*s.* 6*d. net.*

The establishment of a Negro state in West Africa was an interesting experiment in political science, and even if Mr. Reeve's somewhat pessimistic views are not accepted, useful warnings may be drawn from the history of Liberia. First, the Liberian constitution was drawn up by an American lawyer, who modelled it almost entirely upon the American constitution, with little or no regard for the conditions prevailing in Liberia. Thus from the beginning the governmental system was alien to the great body of the people. The manner in which that system has been worked has done little to weld Liberia into an integral state. There exists the harmful division into two sections, the smaller composed of those Mr. Reeve calls the Liberio-Americans,

virtually the rulers, and the very much larger body of African aboriginals. Judged from the present account, the politicians are guilty of many of those dubious practices which give ground for the common indictment against popular institutions—graft, peculation, log rolling.

Mr. Reeve maintains that the interior of Liberia, with its population of two millions, is regarded by the government in power solely as a source of revenue and billets. No attempt is made to develop it commercially or to confer upon it even those material benefits which white domination has introduced to parts of Africa. Trade and order imposed from outside may not spell progress, but at least the aboriginal population of the interior has some claims to be spared the ravages of war, slavery, and the other miseries with the infliction of which, under various disguises and pretexts, the government is definitely charged in this book. The difficulties in the way of reform are admittedly great. Mr. Reeve, writing throughout as the "candid friend," does not advocate the annexation of Liberia by a "great power": but on behalf of the aboriginal population he urges the need for the Liberians to undergo a period of tutelage until such time as they are fitted to govern not only themselves but also the subject races entrusted to them.

Race Problems in the New Africa.— Rev. W. C. Willoughby, F.R.A.I. Oxford: Clarendon Press. 1923. 9 × 6, pp. 296. *Sketch-maps.* 15*s. net.*

The author of this excellent book in reality deals more particularly with the Negroes speaking Bantu languages in Trans-Zambezian Africa. He has evidently been in his time acquainted with the natives of East and Central, but not of West, and doubtfully of North Africa. The freshest, most-felt and studied portions of his distinctly interesting book are concerned with the Kafir-Zulu, Bechuana, and Karanga peoples of South Africa. All that he has to say concerning the South African Bantu is well worth reading. He is a reasonable man; sees the native weaknesses as well as the overbearing attitude and greedy impatience of some white men. In this direction he brings home to his thoughtful readers how much the white man's civilization has owed to the work of nineteenth and twentieth century Christian missionaries in Africa.

One mistake his reviewer has to signalize, though it is shared by many workers in the same field: the South and Central African "Bantu" is a Negro, just as much as the black peoples of the western prolongation of Africa, of the Sudan, and the western confines of Abyssinia. Many different Negro types—Congo pygmies, handsome tall Negroids, burly Swahilis dashed with Arab blood, Hottentot-featured Bechuana, and furtive Forest Negroes of the Congo basin—speak Bantu languages, and may be closely matched in physical type by other Negro tribes who do not. The real, valuable scope of the work under review is confined to a survey of Race Problems in Africa south of the Zambezi. H. H. J.

AMERICA

Annual Report of the Topographical Survey of Canada, 1922–23. Ottawa: Department of the Interior. 1924. 9 × 6½, pp. 56.

There is probably no country where the insistence of the calls for survey is more frequent or more essential than in Canada, and the impression obtained from the report is, perhaps peculiarly, that of endeavour to meet conflicting demands over a vast area. From the geographical point of view it is good to learn that the immediate pressure of survey work connected with the settlement of an agricultural population, which, as the report points out,

has been the principal duty of the department for fifty years, is beginning to relax. The examination and classification of the land and its measurement and marking out have been carried out over enormous tracts, and although these duties will remain, it is possible that the department, while coping satisfactorily with extension of settlement, may in future be able to devote a still larger share of its energies than heretofore to the preparation of the topographical maps of the country.

. The index map to the sectional sheets, which accompanies the report, covers the four western provinces as far north as about the 59th parallel and includes some two hundred sheets of the sectional map. One hundred and thirty-three of these sheets are shown as printed, twelve of them being described as showing detailed information, and ten, including those of the field work, as under revision in order to show such information. It is, however, only the revised sheets which appear to be topographical maps in the modern sense of the term. On the most recent sheets ground features are shown by approximate contours or form-lines at 50 feet or 100 feet v. i. (the scale being 3 inches to 1 mile). Many of the other sheets show merely a skeleton topography, such as waterways, water areas, and principal sites and communications.

The photographic survey obtained covered some 560 square miles. Canada has led the way in the use of the camera as an instrument for normal topographical surveys over large areas, and it is many years since Dr. Deville proved its value, used from view points, for surveying the topography of the Rocky Mountains, where conditions of terrain, transport, and climate particularly favour the method.

The description of exploration surveys does not enlarge on the difficulties and expense, but it is significant that, merely to reach the starting-point of its work 110 miles down the Mackenzie River from Fort Norman, one party had to travel from its railhead about 20 miles by wagon to the Peace River, then 140 up that river by water, 40 to the Blueberry River by wagon, 80 thence to the Sikanni by pack train, and then some 860 by water down that river and the Fort Nelson, Liard, and Mackenzie rivers. These distances, which are only roughly approximate, conjure up a picture of the preliminary journey which gives some suggestion of the remoteness and difficulties of a Canadian surveyor's work in the Far North. The party traversed down the Mackenzie to the delta at its mouth. The " stadia parties," primarily organized for the investigation of water areas, yielded a considerable amount of miscellaneous survey in addition to their normal work, which consisted of the survey of about 1000 miles of shore-line.

The establishment of travelling parties for miscellaneous work is a somewhat special feature of the Canadian surveys. Necessary as small scattered surveys often are, the expense of arranging for them and the dispersion of strength they entail is probably familiar in most survey departments as being out of proportion to their professional results, and it would be interesting to have some information as to the incidence of the cost of these parties.

Other points of special interest in the report are the adjustment of the nets of secondary and tertiary levels in the south of the prairie provinces to the latest adjustment of the precise level net, the use of aeroplanes in reconnaissance for triangulation, the extension of the astronomical field tables for the use of land surveyors from latitude 56° to latitude 70°, which marks the northward spread of settlement, the publication of a new set of magnetic maps for the epoch 1923 to replace those for the epoch 1917, and the

proposal to publish in a separate monograph the magnetic data obtained from some eighteen thousand observations after making the necessary fresh reductions for repeat observations.

It would render the report more useful to geographers unfamiliar with the details of the department if some brief explanation of the system of "townships" and "ranges," and of the "principal" and other meridians, which are serially numbered, were given, and if the values of meridians and parallels were shown in the borders of the index maps. Although cost rates of survey-work, without a fairly complete statement of conditions affecting them, are apt to be very misleading, some indication of the cost of the various branches of the work would be interesting and useful; probably these are given in full detail in some other publication of the department.

Surveyors will be glad to see that Dr. Deville has been confirmed in his new position as Director-General of Surveys. W. M. C.

In Quest of El Dorado.— Stephen Graham. London: Macmillan & Co., Ltd. 1924. 9 × 6, pp. xiii. + 346. 12*s. net.*

Mr. Stephen Graham has undertaken many journeys in his time. His latest book is the record of his pilgrimage in the track of Columbus and the Conquistadores to the Indies and New Spain. He was not, however, to contemplate uninterruptedly the scenes of the present through the eyes of the past. When his journey began in Madrid the historical setting was disturbed by no note of jarring modernity, but as he progressed it grew more and more insistent. The "cocktails and cigar" atmosphere of Cuba, the garrison of American marines in San Domingo, and Porto Rico, where "a whole population of American citizens was without English, and did not know George Washington from Abraham Lincoln," all but succeeded in banishing Columbus and the Spanish explorers from his mind. The cause of this transition he found symbolized in the Panama Canal, which stands to him for the present trend of American development, when "Go South" has superseded the older, and in his view better, cry of "Go West." Finally, however, he does reach some portion of the America he was seeking in the Pueblo Indian Settlements of New Mexico, despite the proximity of a "highbrow" literary colony at Santa Fé.

HISTORICAL GEOGRAPHY

Pigafetta: Relation du premier voyage autour du monde par Magellan, 1519–22. Édition du texte français par **J. Denucé.** Antwerp and Paris: E. Leroux. 1923. 11 × 5½, pp. 290. *Reproductions.* 50 *francs.*

The first printed edition of Pigafetta's narrative was printed in French at Paris, between the years 1526 and 1536, when the first Italian edition appeared. The work had, however, circulated in manuscript before its publication. Four manuscript versions (approximately contemporary) exist at present, three French and one Italian. The French manuscripts, the best of which is that in the possession of Mr. Fitzroy Fenwick of Cheltenham, all bear certain resemblances to each other, and M. Denucé argues in his introduction that they derive from the Italian version. Previously it has been held that the narrative was originally composed in French. In the present volume he prints the older of the two French manuscripts in the 'Bibliothèque Nationale,' and gives in the footnotes every divergence between it and the others, including the Italian version. The interest of the volume would be great if it revealed any striking difference between these French versions and the accepted text. As it is, M. Denucé's work shows that in the main the French texts follow the

Italian closely. The additions and glosses are of little importance, while the French translators have often omitted technical terms and have expurgated certain passages. An amusing mistake is quoted, where "lo suo Alchoranno" (his Koran) is translated "sa couronne"!

MATHEMATICAL AND PHYSICAL GEOGRAPHY

The Problem of Atlantis.— Lewis Spence. 9 × 5½, pp. xii. + 232. *Illustrations.* London: W. Rider & Sons. 1924. 10*s.* 6*d. net.*

Mr. Spence has set himself a formidable task, but one that was worth attempting. He begins with Plato's story, derived from Egyptian sources, of a power that pressed eastward from an island beyond the Pillars of Hercules into the Mediterranean. In this tale Mr. Spence finds strong but not conclusive evidence of Atlantis; he looks for confirmation to geology, oceanography, archæology, and anthropology, and claims that on the whole he has found it. His main conclusions are that three waves of invasion reached Europe from the foundering Atlantis: the first, the Aurignacian or Crô-Magnon, some 25,000 years ago; the second, the Magdalenian, about 16,000 years ago, and the third, the Azilian, some 10,000 years ago; the first two and probably the last reached Europe by land. The Atlantean civilization, he believes, also reached America, and he finds confirmation in Maya traditions, and explains his reasons for thinking that Egyptian influences reached the Aztecs and Incas by way of Atlantis and not the Pacific. At the time of the final disappearance he believes that Atlantis enjoyed a civilization closely akin to that of ancient Central America.

In every myth there is no doubt a germ of truth, and Plato's story must have some explanation, but in reading this book one cannot help feeling that the author believes more than the evidence warrants. We may grant that there were at one time land connections across parts of the Atlantic basin, but the trend of evidence favours their disappearance in Tertiary times. If these represented Plato's Atlantis they must have persisted until at least 25,000 years ago, and of this there is no strong evidence. It should however be noted that in a recent paper in *La Géographie* (Sept.–Oct. 1923), which appeared too late for notice in this volume, Messrs. Germain, Joubin and Danois, writing on the past history of the North Atlantic, admit that in Pleistocene times Atlantis may have existed as a string of islands, the remnant of a continent which by Miocene times had become much reduced and occupied the site of the Sargasso Sea, separated from America, Europe, and Africa (see *Journal*, vol. **63**, p. 85).

Mr. Spence does not explain why he believes that the Atlantic abyss as a whole is of comparatively recent origin. He places Atlantis, or at least its last remnant, on the Dolphin ridge of which he says the islands are "obviously the mountain peaks of this sunken continent." But why "obviously"? By the way, he is wrong in saying this ridge ends in the south in Tristan da Cunha, or that the North Atlantic part is connected by a "submarine spit or peninsula with South America"; and St. Paul's is not a West African island. The remarkable changes in depths reported in the South Atlantic in 1923 which "sent a thrill of surprise throughout the civilized world" were contradicted by the Eastern Telegraph Co., which was said to have discovered them (*Geog. Journ.*, **62**, p. 319). Another mistake is the author's location of Lemuria in the Pacific Ocean, but this has no bearing on his main argument. Nor has his reference to Wegener's hypothesis, but he is rash in stating that there is proof that Greenland has moved 2500 yards in forty years. Col.

Sir C. Close has recently showed the fallacy underlying this argument (*Geog. Journ.*, **63**, p. 147). Much attention is paid to P. Termier's arguments which appeared in 1913. That distinguished French writer records the discovery by a cable ship, 500 miles north of the Azores, at a depth of 1700 fathoms, of a specimen of trachylyte. If lava can consolidate in a vitreous state only under atmospheric pressure, this occurrence would appear to indicate lost land, but it is due to quick loss of temperature that lava takes this form, and so there is no valid reason why a vitreous lava should not be formed in great ocean depths. Faunal relationships provide surer evidence of an Atlantean land bridge, and certainly allow us to concede that the Cape Verde and Canary Islands are fragments of a larger Africa. The Azores however are true volcanic islands, and there is no evidence to show former land connections with each side of the Atlantic basin.

Mr. Spence is an industrious writer, and, even if he fails to convince, has done service in marshalling the evidence and has produced an entertaining volume which is well worth reading. The lack of an index is a serious blemish in a book of this nature. R. N. R. B.

The Realm of Nature: an Outline of Physiography.— Hugh Robert Mill, D.Sc., LL.D. 3rd Edition. London: John Murray. 1924. $7\frac{1}{2} \times 5$, pp. xii. + 404. 20 *Plates*, 73 *Text-figures*. *7s. 6d. net.*

To be reprinted nine times in the course of a third of a century, to reappear in a third edition without any change from the original plan, and with the bulk of the text unaltered, and yet to be as useful as at first, is a very creditable record for a popular scientific work. It is interesting to compare this new edition with the first. The most striking innovation is the replacement of the coloured Mercator world-maps by others on the Mollweide projection. This undoubtedly gives a better series of distribution maps, though in a case where direction is of importance (*e.g.* circulation of winds) the improvement is doubtful. When a wind, for instance, is marked by an arrow at right angles to the 160th meridian in 50° N. lat., it would need a mathematician to determine its real bearing.

The text throughout shows evidence of most careful revision in the light of new knowledge (though much of this may date from the second edition of 1913). Old generalizations have been qualified, and new matter skilfully woven in. We have only noticed one case of an added sentence that is liable to be misunderstood. This is on p. 265, where the words "These appearances are often spoken of as Karst phenomena . . ." might be taken by a beginner as referring to the last phenomena described (the submarine welling-up of fresh water) instead of to the paragraph as a whole. As might be expected from the author's special line of work for many years, the greatest changes and additions are in the section on meteorology, the only one in which an additional chapter has had to be intercalated. In several places, notably in the account of the general atmospheric circulation, cautionary sentences have been introduced, warning the reader that the real facts are more complex and less diagrammatic than he would perhaps like them to be. With so wide a range of subject-matter the author cannot hope to satisfy every one, and the particular grumble of the present reviewer is that the section on earthquakes remains practically untouched. The connection of earthquakes and faults is just mentioned, but there is no reference to the evidence given by the San Francisco and other recent earthquakes, nor to the use of isoseismal lines in locating the epicentre and the results obtained by Dr. Davison on applying this method to British earthquakes. But this is a minor criticism.

Already in the second edition the numbering of the sections and the index-reference to these instead of to pages had been discarded, a source of some irritation to the user of the index in the first edition having thus been removed, while the book has also acquired a less pedagogic aspect.

It is striking evidence of the scientific value of Antarctic exploration that in almost every part of the book Antarctic discoveries have necessitated modifications of statement. A. M. D.

GENERAL

Le blé dans le monde.— **René Musset.** Paris: Berger Levrault. 1923. 9 × 5½, pp. x. + 199. *Sketch-maps and Diagrams.* 9 *frs. net.*

This is a clear and concise account of wheat as one of the great commercia commodities. After describing the physical conditions necessary for its growth, M. Musset treats each of the main wheat regions of the world individually as consumers and producers. The interplay of the various factors, physical, social, political, governing supply and demand, are thus brought out clearly. He is naturally prone to insist upon the advantages of the almost self-sufficing position of France, as opposed to that of Great Britain, though in this connection he does not mention that the latter obtains 40 per cent. of her imported wheat from within her Empire, a great proportion from Canada. This fact is perhaps more significant when the international position of wheat production is examined. As M. Musset points out, the demand for wheat is increasing, Russia's export is negligible, and the United States is also becoming less and less an exporter. Canada, in his opinion, is the country from which a great increase in export may be expected, the Argentine and Australia following next.

Merchant Ship Types.— **A. C. Hardy.** London: Chapman & Hall, Ltd. 1924. 8½ × 6, pp. x. + 316. *Illustrations, Plans, Silhouettes.* 15*s. net.*

This book will appeal primarily to students of naval architecture and marine engineering, but the subject with which it deals and the clear way it is set out should make it of interest to the general reader. The "steamship" is the main type described; the use of internal combustion engines is considered, but the sailing vessel neglected entirely. The author divides his subject into two main heads, ocean transport and sea, including coastal, transport. Each of these is again divided into three groups according to the traffic carried—passenger, cargo, or intermediate. In this way the requirements of each particular service can be set forth under capacity, character of cargo, economic speed, etc., the general principles governing construction deduced, and their actual application in practice shown by figures and plans. For instance, examples of the influence of varying conditions on construction are clearly shown by the fast cross-channel passenger boats and the bulk freighters of the Great Lakes. In the first case, the main requirements are a speedy run and a rapid "turn round," sometimes involving a low rudder for manœuvring in an extremely tidal port, and a specially strengthened hull if required to lie aground in harbour, together with limited draught, and large passenger accommodation. These factors produce a vessel often of graceful lines at once suggestive of speed. On the Great Lakes, where the essentials are cargo capacity, rapid loading and unloading, limited draught and speed, a vessel described as a "long, bluff, narrow, and deep box, ship-shape at the ends," has been evolved. This is but one instance of the connection between geographical factors and marine construction, a connection to which the author gives due emphasis throughout his informative book.

THE MONTHLY RECORD

EUROPE

The First Large-scale Plan of Bristol, by James Millerd, 1673.

WE have received from Mr. John E. Pritchard, F.S.A., the reprint of a paper by him in vol. 44 of the *Transactions of the Bristol and Gloucestershire Archæological Society*, on the recent discovery of the original issue (1673) of the great plan of Bristol by James Millerd, of which no copy had previously been known. That it was eventually brought to light was due to the publication in 1921 of a previous paper by Mr. Pritchard on old plans of Bristol, which came to the notice of its owner and recalled to mind a roll of old engravings (one of which was Millerd's plan) obtained by him from North Italy some years ago. Millerd was a mercer in business in Bristol, and the plan was his own original work, as he had no earlier plan of any real value to assist him. It was engraved on copper in four sections, and its title runs: "AN EXACT DELINEATION OF THE FAMOUS CITTY OF BRISTOLL AND SUBURBS thereof, together with all the High wayes, through-fares, streets, lanes, and public passages, therein Contained, Composed by a Scale Ichonographically Described Engraven & Published by Ia: Millerd, Cittizen & Inhabitant there." In the "Term Catalogue" of the period (1668–1709) we find the statement that this "exact Map was published in four sheets, encompassed with a large Firdor showing most of the principal Buildings therein contained (never before extant)." (The word "Firdor," referring to the pictorial border, seems to be otherwise unknown.) Together with this border the plan measures 2 feet 9 inches by 2 feet 6½ inches, and the imprint states that it was "sould by John Overton * at the White horse without Newgate, London. And by Thomas Wall, Bookseller in Bristoll." Besides this original issue, three others (of about 1684, 1696, and 1728–30) are known, and from a reference in the last to the Great House as "now 1710 Colston's Hospitall for Boys" it would appear that there must have been still another of the last-named date. These successive issues, all of great rarity, are particularly valuable for the light which they throw on the growth and changes in the city during the period covered by them. Millerd's plan seems to stand above all contemporaneous plans of English cities, both for its scale and the extent of information given respecting public buildings and so forth. The first issue has now been acquired for the City collection.

The Population of Spain.

The general returns of the Spanish census for 1920 are analysed by M. Max Sorre in *Annales de Géographie*, 15 March 1924. The population, including travellers, was 21,338,381; and excluding the figures for the Canaries and the Balearic Islands, this gives an average density of 41·7 per sq. kilometre. The increase during the last decade, 1911–20, was 6·95 per cent.; for the previous decade it was 7·22 per cent. The first figure is apparently not reconcilable with other returns, for in the same period the excess of births over deaths is less by some 67,000 than the total increase recorded, while the number of persons leaving the country by sea was greater than those entering. From the map showing the densities of population of the various provinces, the extreme inequality of its distribution and the situation of thickly peopled areas

* Overton was a well-known publisher of maps, including re-issues of many by Saxton, Norden, and Speed.

around the coast are immediately apparent. For Soria, the least densely populated province, the average is 14·7 per sq. km.; for the provinces of Biscaye, including Bilbao and Barcelona, the figures are 189·13 and 175·46 respectively. Neglecting towns of more than 100,000 inhabitants, the provinces may be divided into three main groups: that of the Mediterranean littoral and of southern Spain, which with the towns account for 42 per cent. of the population and 28 per cent. of the area of Spain; that of the interior provinces of southern and western Spain, for which the figures are 39 per cent. of the population and 61 per cent. of the area: and the Atlantic group, including Basque Provinces, Asturias, and Galicia, where 18·9 of the total population live on 9 per cent. of the area. The article also contains a sketch-map showing the movement of population during the years 1910–20. From it two main tendencies are evident: first, there exists a large zone of depopulation in northern Spain stretching from the Portuguese frontier, across old Castile and the provinces of Soria and Castellón de la Plana, to the Mediterranean. In southern Spain, on the other hand, there is a considerable area where the increase has exceeded 10 per cent. This covers Cadiz, the three provinces along the Guadalquivir and the Meseta provinces of Ciudad Real and Albacete. The other areas of increase are much more localized, *e.g.* Madrid and Barcelona. This contrast is apparently a recent development, and cannot altogether be attributed to natural causes, for though several of the provinces of southern Spain show the highest birthrate, the Mediterranean provinces, except Lugo and Orense, have the lowest, and the provinces within the zone of depopulation have a rate above the average. It is also noticeable that the areas to which there is a movement of population do not coincide with those of great density. The greater part of this movement is towards urban centres. The increase for the provincial capitals is 17 per cent., for other towns of more than 20,000 inhabitants it is 14·6, while for the whole Spanish population it is only 6·95. Madrid remains the largest city, with a population of 750,896; followed by Barcelona (with 710,335), Valencia, Seville, and Malaga.

ASIA

Dr. A. Legendre's Travels in Shansi.

The French traveller Dr. Legendre, well known for his extended researches in Western and Southern China before the war, has lately carried out an interesting journey of exploration in the south-east of Shansi, and has thus made himself acquainted with a part of China which differs greatly in many respects from the parts previously known to him. He sums up the broad results in a letter to the President of the Paris Geographical Society printed in *La Géographie* for March 1924. The whole of the region visited has the character of a high plateau, with a mean elevation of 1500 metres. As in the Tibetan borderlands of Western China, it is traversed by narrow straight valleys, widening frequently into lacustrine basins, the few and short gorges of erosion being without importance. We have to do with phenomena of fracture and subsidence, as well as with well-marked systems of folding and dislocations which entirely reverse the normal position of the strata—this last being particularly the case with certain limestones of Carboniferous age. The only evidence of eruptive action consisted of an intrusive mass of granitic rocks south of Ping Yao, intercalated between metamorphic schists and quartzites. This eruptive action was very localised, covering only some 10 kilometres along the chain bordering the valley of the Fong Ho. Dr. Legendre was able to collect a large number of fossils which will permit the

age of the strata to be determined. His careful observations of the *loess* of Shansi lead him to conclusions at variance with those of Richthofen, for he thinks that, like other deposits studied in his former journeys in South-West China, it is of fluviatile rather than æolian origin. It was particularly as regards the flora that Dr. Legendre was struck with the contrast between Shansi and Western China. This is due not only to climatic differences (Shansi being both colder and drier than Szechwan and Yunnan), but to the barrier offered by the Tsin-ling range. Among the common plants are the wild thyme, fumitory, shepherd's purse, *Myosotis*, and on the mountain slopes immense quantities of white lilacs ; but most characteristic of all are species of *Artemisia* and *Chenopodium*. Willows, poplars, and elms reach an enormous size, but are allowed to grow only round pagodas or funerary *tumuli*. In fact, the insensate destruction of everything in the nature of a tree or bush goes on unchecked, with deplorable results here as elsewhere, the cultivable surface becoming yearly less and less as a result of erosion, and in another twenty-five years the ruin will be complete. The present governor, a most enlightened man, of whose aid during the whole journey Dr. Legendre speaks in warm terms, was the only man whom he found in the least able to grasp the seriousness of the situation, and the need for a policy of re-forestation.

The Alkaline Lakes of Sind.

The soda deposits of the Sind desert, which have been exploited locally on a small scale from time immemorial, attracted attention during the war as a possible source of supply to Europe, and in the winter of 1918–19 Mr. G. de P. Cotter, of the Geological Survey of India, received orders to undertake an examination of the deposits on the spot. His report, published last year in the *Memoirs of the Geological Survey of India* (vol. **47**, part 2) is interesting as well for its general description of the physical features of the area in which the deposits occur as for the conclusions arrived at regarding the origin of the deposits and possibilities of further development of the soda industry. The part of Sind under consideration lies east of the lower Indus, and is bisected in a north-south direction by the East Nara Canal. It is entirely covered by alluvial clays or by wind-blown sand, there being no visible outcrops of rock. The clays and silts of the alluvial area are highly impervious to water. Much of the soil is unfit for cultivation, being highly charged with mineral salts, but supporting a few small shrubs of the Goosefoot order (*Salsola*, *Sueda*), as well as the Tamarisk. The tract covered with wind-blown sand lies east of the Nara and north of the Jamrao Canal. Towards the south the sandhills are aligned in long unconnected ridges (*bhits*), parallel to the direction of the monsoon winds, the valleys between being known as *talis;* but further north the *bhits* become more and more connected by transverse ridges, until at last the arrangement appears to be almost haphazard. In the eastern part of the Khairpur State so much sand has been deposited as deeply to cover the whole face of the country, disposed on the surface in irregular curves of hills and hollows which greatly lengthen the distance to be traversed in getting from one point to another. These sandy plateaux are known as *dra-ins*. The Sind desert receives an appreciable amount of rain, and the *bhits* and *talis* have quite a vigorous flora. Some at least of the rainfall is absorbed by the sand and sinks down till held up by the underlying clay, emerging in any low-lying places to form marshes or lakes (*dhands*). The water in these may be strongly alkaline or saline, due to the salts derived by the percolating water from the buried soil. Though often large expanses, the *dhands* are never very deep, and the shallower and smaller they are the greater is the concentration of the

solution. They vary in depth according to season, and it is those of medium size and slight depth, which deposit their soda without drying up completely, from which the best quality of soda is obtained. The cutting of the Nara Canal, diverting the water to the alluvial plains to the west, has dried up many of the *dhands* to the east of it. The sand-plateaux or *dra-ins* form reservoirs for the absorption of the rains, and the water supplied to the *dhands* on their margin is largely fresh. There is a marked difference between the alkaline and saline *dhands*, the former supporting much more vegetation than the latter, where however tamarisk bushes are common. Gypsum crystallizes round these until in time the resemblance to a tree is lost, and there is a small round hillock with innumerable rounded knobs. The mineral obtained from the *dhands* has been proved by analysis to be Trona (known locally as *kaniho*), but in recent years the total yearly production has not greatly exceeded 40,000 *maunds* (27·2 to the ton), much of it being exported to Karachi, Bombay, and Basra. Mr. Cotter is cautious as to the possibilities of commercial exploitation.

The Eruption of 1923 in the China Sea.

We have received through the courtesy of the Hydrographer further details regarding the two new volcanic islands in the China Sea, the formation of which was noted in the *Journal*, **62**, pp. 35 and 153. The Admiralty Notice to Mariners, No. 812 of 1924, contains the results of a further visit of H.M.S. *Iroquois* to the area in March 1924. It will be remembered that on her visit last year two new volcanic islands were observed in approximately lat. 10° 09′ N., long. 109° 00′ E., and a shoal bank in 10° 9′ 27″ N., 109° 0′ 50″ E., with a depth over it of 12 fathoms. It is now reported by H.M.S. *Iroquois* that these two active volcanoes have subsided, a depth of about 50 fathoms over the original sites being now shown on the accompanying reproduction of parts of charts 1261 and 2660*a*. The examination failed to reveal any trace of the 12-fathom bank or the shoal awash in this area, and they have been omitted from the charts in consequence. The notice also states: "No sign of further volcanic activity was observed at the time, but, as indicated on the reproduction, caution is to be used when navigating in this neighbourhood."

AFRICA

New Italian Boundaries in Africa.

A convention regulating the frontiers between Italian Somaliland and Kenya was signed in London in July, after protracted negotiations. The frontier was formerly the river Juba. Under the Pact of London, 1915, Italy was promised territorial compensation in this area. After negotiations between Lord Milner and Signor Scialoja in 1920, a frontier was provisionally agreed upon. The line ran from Dolo south-west to El Wak, thence down the 41st meridian of East longitude, and then south-east to the coast at Dick's Head. After that date the issue was obscured by other complications, but this line has now been accepted by both sides. Under the settlement Italy gains the two ports of Kismayu and Port Durnford. In return for the inclusion of the latter, Italy is to renounce certain prescriptive rights in Zanzibar. The question of the control of the nomadic frontier tribes is to be settled by the British and Italian governors on the spot. The rectification of the boundary between Tripoli and the French Sahara south of Tunis, agreed on in principle by the same pact, has also been ratified at last by the French Chamber, after considerable delay (Bollet. R. Soc. Geogr. Italiana, N. 3–4, 1924). Although the oases of Ghadames and Rhat had been recognized as Italian for some

years, France had claimed considerable salients both between these two oases and between Ghat and Tummo, which would have withdrawn from Italian control portions of the old caravan route by Ghadames and Rhat towards Tibesti. These two sections of the boundary have now been straightened out by the assignment to Italy of various oases on the caravan route, with a further shifting of the boundary to the west in order to give Italy a practicable road when the direct line becomes impassable, as it does sometimes in summer.

French University Mission to Morocco.

With the purpose of stimulating interest in the French undertakings in Morocco and spreading a true knowledge of the country, the administration of the Protectorate arranged for a French University Mission to visit the country in October 1923. The mission was not confined solely to geographers, but numbered among its members geologists, jurists, and historians. An entire number of *Annales de Géographie* (15 Mai 1924) is given up to an account of the tour, and to articles both by members of the mission and by government officials. From the 9th to the 26th October, a considerable area was covered, partly by motor, partly by varying local means of transport. Landing at Casablanca, the party visited Marrakesh, Rabat, Meknes, and Fez, besides other places further from the beaten track, and re-embarked at Oran. The first article in the *Annales*, by J. Célérier, gives a detailed account of the country traversed, with particular attention to the physical features and regions and the position of the towns: its geology is detailed separately by J. Savornin. Proofs of the desiccation of a portion of Morocco are advanced by E. de Martonne and others in the course of a morphological study of the Rehamna massif. Here the change in the hydrographic *régime* has been related to deforestation. The present condition of the vegetation of Morocco is detailed by M. Sorre, who, by constructing a provisional vegetation map, has shown its close relation to the rainfall, particularly in the co-incidence of the "Mediterranean" area of the Atlantic coast with that of heavy rains. The native population of Morocco is analysed by MM. A. Bernard and P. Moussard, who correct the impression that it may be divided upon a language basis into Arabs and Berbers, for a great part of the Arab-speaking people are racially Berbers. The distribution of the Berber-speaking population follows very closely the physical relief of the country. As would be expected, the Berbers inhabit the mountains, the Arabs the plateaux and plains, with intermediate bi-lingual areas. As to the French civil population, it appears from a note by G. Jacqueton on "La colonisation français au Maroc," that at present it numbers about 55,000. A census, taken in March 1921, showed that of the total civil population of 49,000, 41,000 were living in the towns, notably Casablanca and Rabat. After deducting officials, artisans, and business men from the remainder, the number of agricultural colonists and their families would seem to be little more than 3000. To improve this state of affairs, the government have initiated a scheme under which, between 1918 and 1923 449 lots, amounting altogether to 71,496 hectares, have been settled.

AMERICA

Reelfoot Lake, Tennessee.

A profusely illustrated account of this lake and its formation rather over a century ago is given by Mr. W. A. Wright in an article, "Reelfoot—an earthquake lake," in the *National Geographic Magazine* for January 1924.

The lake is in Western Tennessee, south of the junction of the Ohio and the Mississippi, and was formed by the damming of a river as a result of the New Madrid earthquake of 1811–12. From December 1811 a series of periodic shocks were experienced which culminated in the "hard shock" of February 7. This last is described in a letter of Eliza Bryan, then living at New Madrid. She writes of "a very awful noise," "sulphurous vapour," and fissures in the ground emitting sand and water. "The Mississippi," she writes, "first seemed to recede from its banks, and its waters gathered up like a mountain. . . . Then rising 15 or 20 feet perpendicularly and expanding, as it were, at the same time, the banks overflowed with a retrograde current rapid as a torrent." This earthquake was felt over a wide area of the Mississippi basin. In the Cumberland Mountains, 200 miles to the east, great blocks of sandstone were seen to fall crashing down the escarpment. The Western Tennessee region consists of loam on beds of clay and sand, so that the earthquake there was accompanied by changes in level—New Madrid sank 12 feet—"sand geysers," moving forests, and changes in the course of the Mississippi. Above New Madrid a perpendicular 6-foot drop in the river-bed was reported. The rhythm of the earth-movements which produced Reelfoot Lake is clearly shown in an aerial photo, in which a series of gently curved lines of cypress trees extending across country can be seen. The lake is about 14 miles long and 4 miles wide. It is comparatively shallow, a considerable part being covered by trees (chiefly cypress), yoncopin lilies, and seed moss. It is now the home of many kinds of fish, wild duck, herons, cormorants, and bald eagles, and has been created a State game preserve. The photographs have been taken from the air.

Variation in Run-off in the Rocky Mountain Region.

In 'Water-Supply Paper 520–A' of the United States Geological Survey, Mr. R. Follansbee summarizes the records of run-off in the Rocky Mountain States of Montana, Wyoming, and Colorado, kept during the past thirty years, from the point of view of the variations from year to year. The data show that such variations differ in different areas within the region, owing to the different sources from which precipitation is derived; for the amount of precipitation in any part of the mountain region depends upon the point at which the low-pressure areas, which travel along three well-defined paths, cross the mountains. The most notable discrepancy occurred in 1902, when the run-off was high for streams in Montana, fairly low for streams in Wyoming, and the lowest recorded for streams in Colorado. In 1905, on the other hand, the run-off was low in Montana and Wyoming, but above normal in Colorado. The variation is more uniform for the Colorado streams than for those of the other two states, and more uniform for different parts of the same drainage basin than for different basins. The influence of topography is seen in the fact that streams rising on the eastern and western slopes of the main mountain mass have a greater variation in yearly run-off than those rising near the centre. For the plains streams the variation is greater than for the mountain streams studied, the range in the case of the Cheyenne river being from 32 to 206 per cent. of the mean. In one day in 1920 it reached 244,000 acre-feet, which was greater than the total run-off for either 1916 or 1919, and in two out of six consecutive years it was double the mean. In the plains streams more than others the run-off is governed rather by intensity of rainfall than by total amount, and, as the mean total precipitation here hardly reaches the amount required for transpiration, evaporation,

and percolation, the run-off, depending almost entirely upon intensity of rainfall, must obviously be very uncertain.

White Indians in Panama.

The Times has recently contained reports of the discovery of a tribe of white Indians in Panama. This discovery was made by a scientific expedition, under Mr. R. O. Marsh, which left New York on January 16 for the Pacific coast of Panama, and worked up the Chucunaque River to the Darien region and the Atlantic coast. Two members of the expedition, Prof. J. L. Boer, acting curator of the Smithsonian Institute, and Mr. P. Brin, a Panama Government botanist, died from disease. Through his services in fighting a smallpox epidemic, Mr. Marsh gained the confidence of the Indians. In return, they summoned together the white Indians he wished to see. These white Indians, owing to the hostility of the others, have been forced to take refuge in the mountains and secluded valleys. The tribe is said to number two thousand. This discovery was confirmed by a message from Dr. Breder, the representative of the American Museum of Natural History. Later Mr. Marsh returned to New York with three white Indian children. These have been superficially examined by anthropologists and medical men, who are agreed that the children are not albinos, and that they really are Indians. They have tawny flaxen hair and blue eyes, with features said to resemble those of Cro-Magnon man.

MATHEMATICAL AND PHYSICAL GEOGRAPHY

Spiders as a Clue to Geological History.

In the March number of *La Géographie* for 1924, M. Lucien Berland draws attention to the help which may be given by a study of the Arachnida (spiders and their allies) of the present day towards a knowledge of former land connections in various parts of the world. It has been held by some that this class is valueless for the purpose by reason of the supposed facilities for the transport of species from one place to another. But the writer shows that such objections can be easily refuted, and that if the very limited number of cosmopolitan species be eliminated, the Arachnida fauna of different regions is marked by the large proportion of species which are endemic, that is, peculiar to the particular locality. Again, looking back at the past history of the class in geologic times, we find a remarkable fixity of characters from quite early in the Tertiary period. It might even be said that as far back as the Oligocene the class was already constituted, in its broad lines, as at the present day. M. Berland gives specific instances of the conclusions which may be arrived at through the recognition of these facts. He has lately studied an important collection of Arachnida made in New Caledonia by MM. Sarasin and Roux, and finds that while the majority of the species are endemic, they show the greatest affinity with the Arachnida of Australia (with a less pronounced relationship with New Zealand); on the other hand, the faunas both of Australia and New Caledonia show certain affinities with those of Malaya. This is in close agreement with what we know of the history of the region from geological evidence, the site of New Caledonia having been entirely submerged towards the end of the Eocene, so that its existing fauna must have originated later, when a movement of elevation united it with Malaya, itself in turn connected with Australia; the relationship of the faunas of the latter and New Caledonia, separated by a deep ocean trough, is thus explained. In a similar way M. Berland uses the existing Arachnida as a help to reconstructing past history

in a case where geological and palæontological evidence is entirely lacking. A study of the Arachnida of Easter Island and Juan Fernandez—both entirely volcanic—shows at once their totally different history, Easter Island possessing only cosmopolitan representatives of the class, of relatively recent introduction, so that the island has never been joined to any existing land; while Juan Fernandez has an essentially endemic Arachnida fauna, showing however distinct affinities with that of South America, so that the volcanic massif constituting the group must have been elevated at a time when its site formed part of the South American continent. ' The close parallel presented with the Arachnida fauna of New Caledonia justifies the conclusion that the separation of Juan Fernandez also dates from about the period of the Oligocene.

GENERAL

Geographical Distribution of Water-Power Development.

The geographical conditions of hydraulic power are discussed by Prof. Raoul Blanchard in the January issue of the *Geographical Review* of New York. For the exploitation of hydro-electric force the two essential factors are water and slope, and though these two factors are to a large extent mutually compensatory in that a small quantity of water falling from a great height can effect the same result as a large quantity on a slight slope, the economic advantage rests with the high fall, as it can be equipped and maintained at less expense. To both these requirements glaciated regions make, on the whole, the best response. In the great areas of Europe and North America which were glaciated during the Pleistocene and then received a heavy snowfall, the present-day rainfall is abundant, part of it still falling as snow which, in the Alps, is especially valuable in furnishing a constant supply of snow-water during the summer months. Again, glaciated topographies with their hanging valleys, transverse rock-barriers or *verrous*, and moraine-dams, furnish not merely the steep but also the broken slopes which are so suitable for hydro-electric development. Moreover, glaciated countries, such as Finland, Scandinavia, Scotland, Ireland, the Alps, Pyrenees, Canada, the Cascade Mountains, Southern Andes, and New Zealand Alps, are pre-eminently characterized by lacustrine hydrography, lakes being most efficient regulators of flow. With these advantages, if economic conditions permit, glaciated countries are sure to make use of this source of power. In non-glaciated regions it is rare to find all the factors favourable, and where one does, as along the Lower Congo, economic and technical difficulties may hinder utilization of the power. On the economic side the geographical distribution of hydro-electric industry is affected both by the distance through which it is profitable to transmit power from badly accessible regions, and by the difficulty of maintaining human labour in gloomy and remote mountain valleys. Moreover, mountain locations, otherwise highly favourable, may be blocked with snow for half the year.

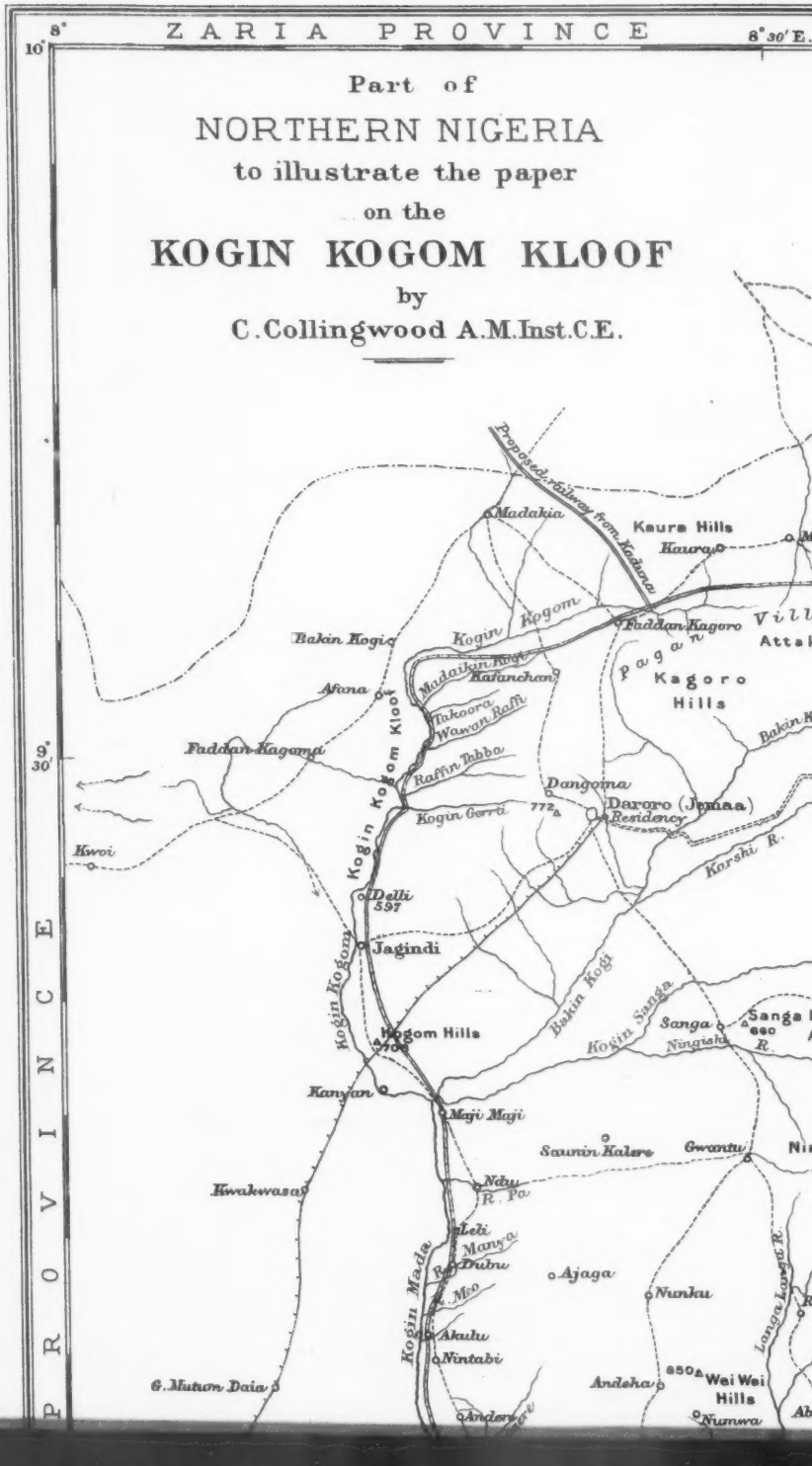
From these general considerations Prof. Blanchard goes on to discuss developments in the two countries stated to have shown the most marked progress—the United States and France, the former leading the world in developed water-power with 9,000,000 h.p., the latter leading Europe with 2,000,000 h.p., ranking after Canada. Of the total hydro-electric power in operation in the States in 1920 about 40 per cent. was produced in the glaciated region of the north-east, 32 per cent. in the glaciated western mountains, and practically all the rest in the non-glaciated region along the

south and east borders of the Appalachians. In France the Alps in 1922 possessed 55·4 per cent. of the total power installed, the Pyrenees 14·5, the Central Plateau 19, the remaining 11 being shared by the lower plains and mountains. The French Alps are in a particularly favourable position both climatically and orographically, and with satisfactory economic conditions have reached a development per unit of area higher than in any other part of the world. There are populous districts along these borders, communications are faciliated by broad deep valleys, and apart from Lyons, St. Etienne, and Marseilles, even Paris is tending more and more to derive power from the Alpine torrents. The Pyrenees are capable of furnishing ample water-power, but are physically much less favourable than the Alps. There is less competition from coal than in the Alps, but the present demand for power in this part of France is small. The mountain lakes or tarns so common in the Pyrenees at elevations between 1800 and 2500 metres (*circ.* 5000 to 7000 feet) were converted under war-time industrial pressure into reservoirs for regularizing the flow of the mountain streams. The Central Massif of France badly needs water-power, but the streams are deficient in volume, irregular in flow, and lacking in steep gradients, while the reservoirs of snow and ice so valuable in the Alps and Pyrenees for tiding over summer shortage are absent.

As regards water-power in Great Britain reference is made to a paper by Mr. A. Newlands (*Journ. Roy. Soc. Arts*, vol. **76**, 1918, pp. 168–188) who points out that though there is enough water-power in the Scottish Highlands to meet a large part of the needs of Scotland, the cost after development and transmission to industrial areas would probably be more than the cost of power generated locally at the pit-head. As regards the British Isles as a whole, it would seem that with progressive modern means of conserving, transforming, and transmitting power, there should be greater possibilities of developments not only of tidal, but also wind-power, at least in the western districts most exposed to Atlantic storms.

Scientific Study of Natural Catastrophes.

We have received a letter from M. Raoul Montandon, President of the Geographical Society of Geneva, asking for support for the forthcoming quarterly, *Materiaux pour L'étude des Calamités*, which that Society is editing on behalf of the International Red Cross Committee and the League of Red Cross Societies. Its purpose is to promote the scientific study of natural catastrophes, such as earthquakes, floods, epidemics, and to prepare plans for dealing with these emergencies. The idea of international co-operation to this end was initiated by Senator G. Ciraolo, President of the Italian Red Cross, in 1923. The Editor of the *Materiaux* would welcome the support of scientific societies and of individuals for this project, and their assistance in compiling the necessary information.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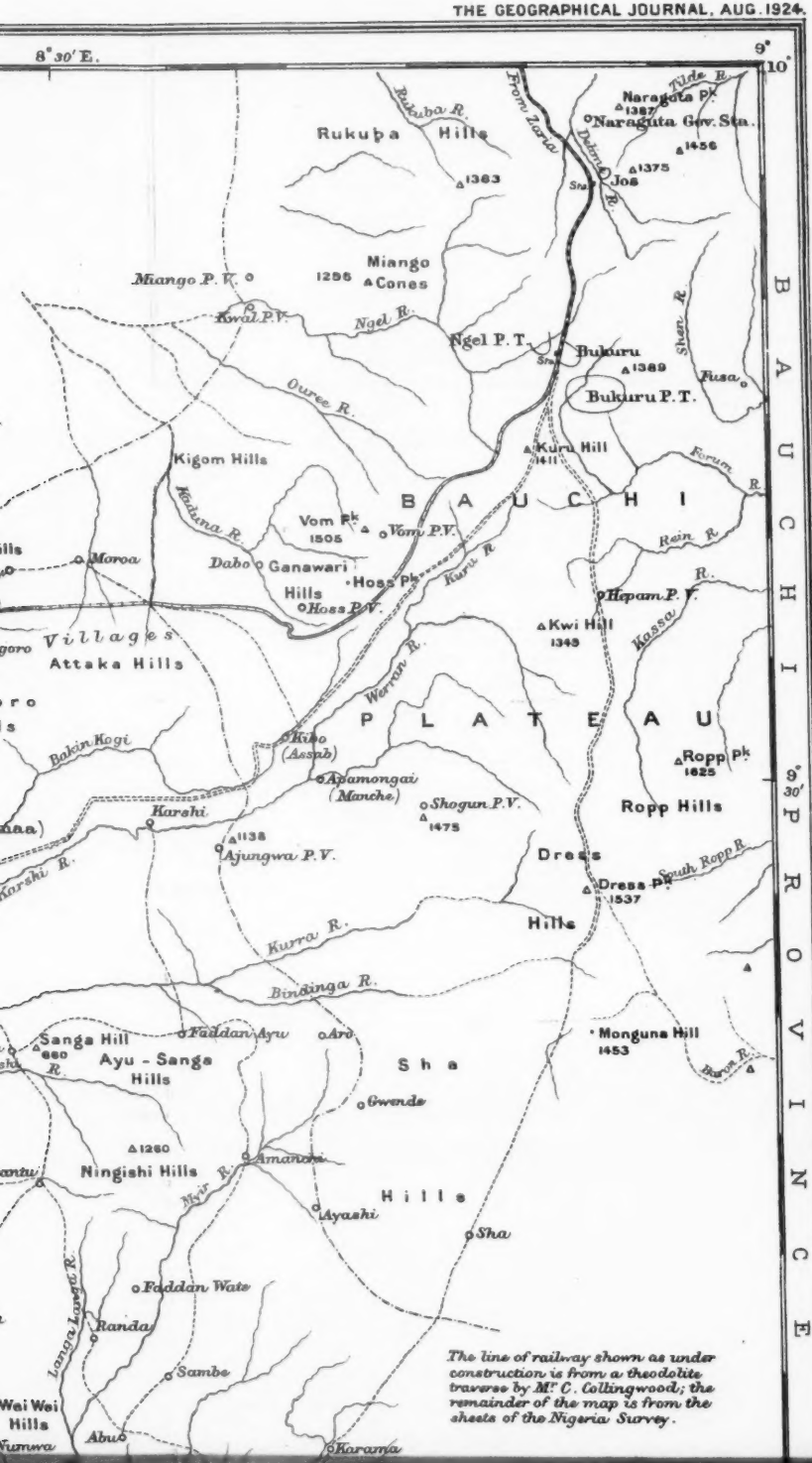
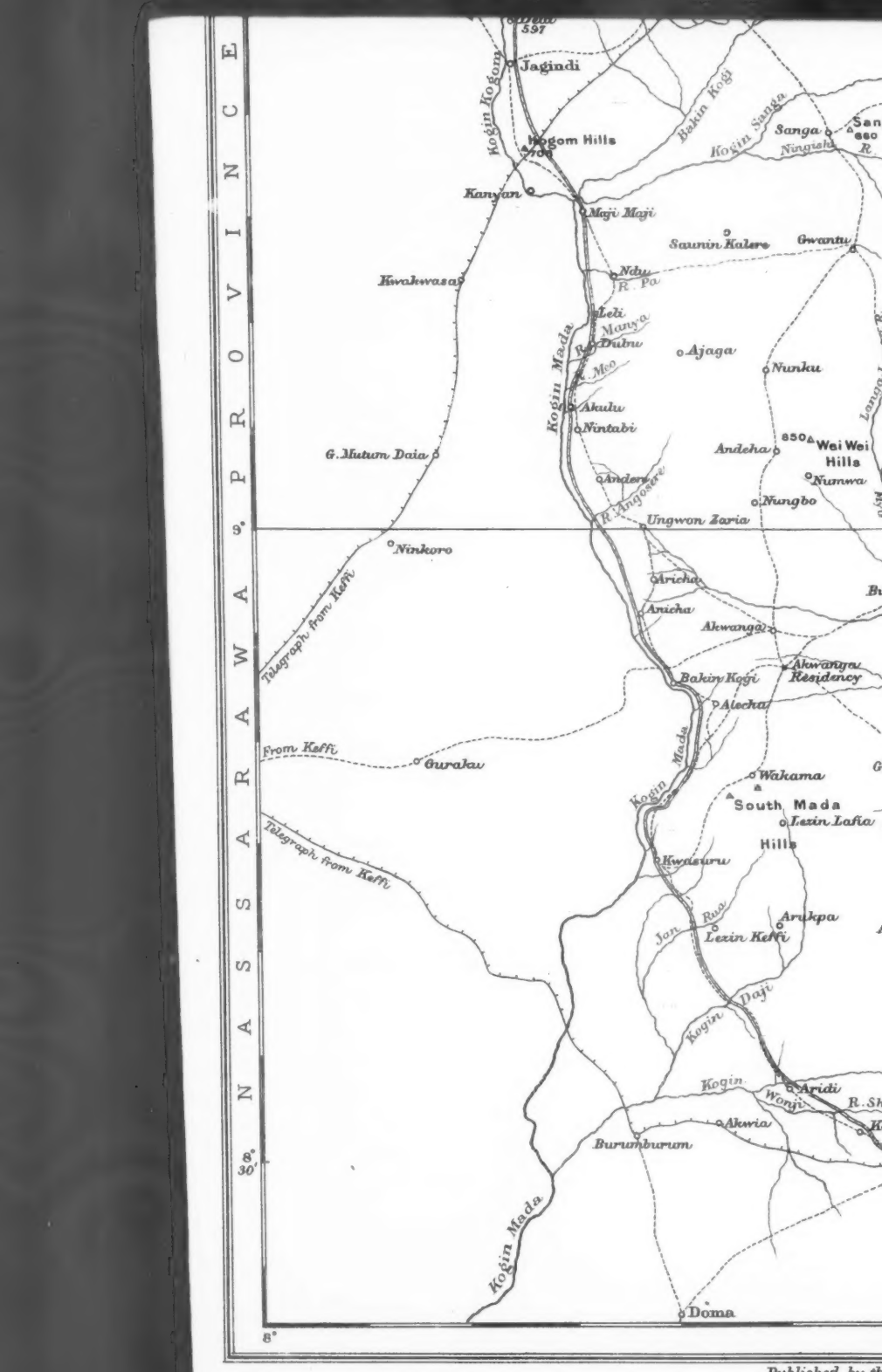


The line of railway shown as under construction is from a theodolite traverse by Mr C. Collingwood; the remainder of the map is from the sheets of the Nigeria Survey.



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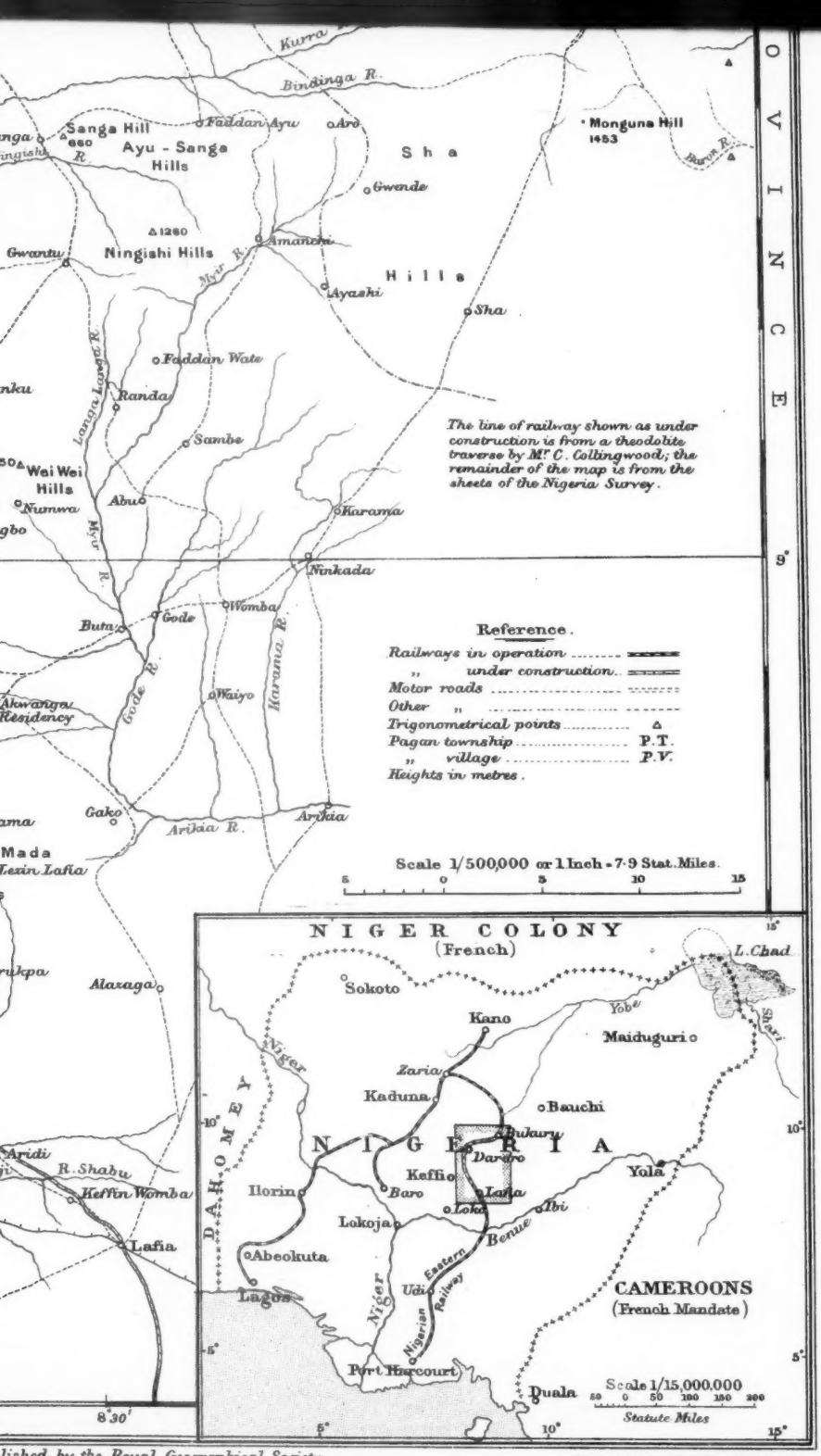

lished by the Royal Geographical Society.

KOGIN KOGOM KLOOF
Collingwood.